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NEW YORK AND LONDON

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WORLD PETROLEUM

RUSSELL PALMER
Publisher

E. W. Mayo
Editor

T. Orchard Lisle
Executive Editor

E. W. Mayo, Jr.
Managing Editor

S. J. Gallay
Advertising Manager

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CORRESPONDENCE

ADDRESS all correspondence regarding editorial, advertising, subscription and business matters to the Home Office; 95 River Street, Hoboken, N. J. Telephone Rector 2-2043 or Hoboken 3-2480.

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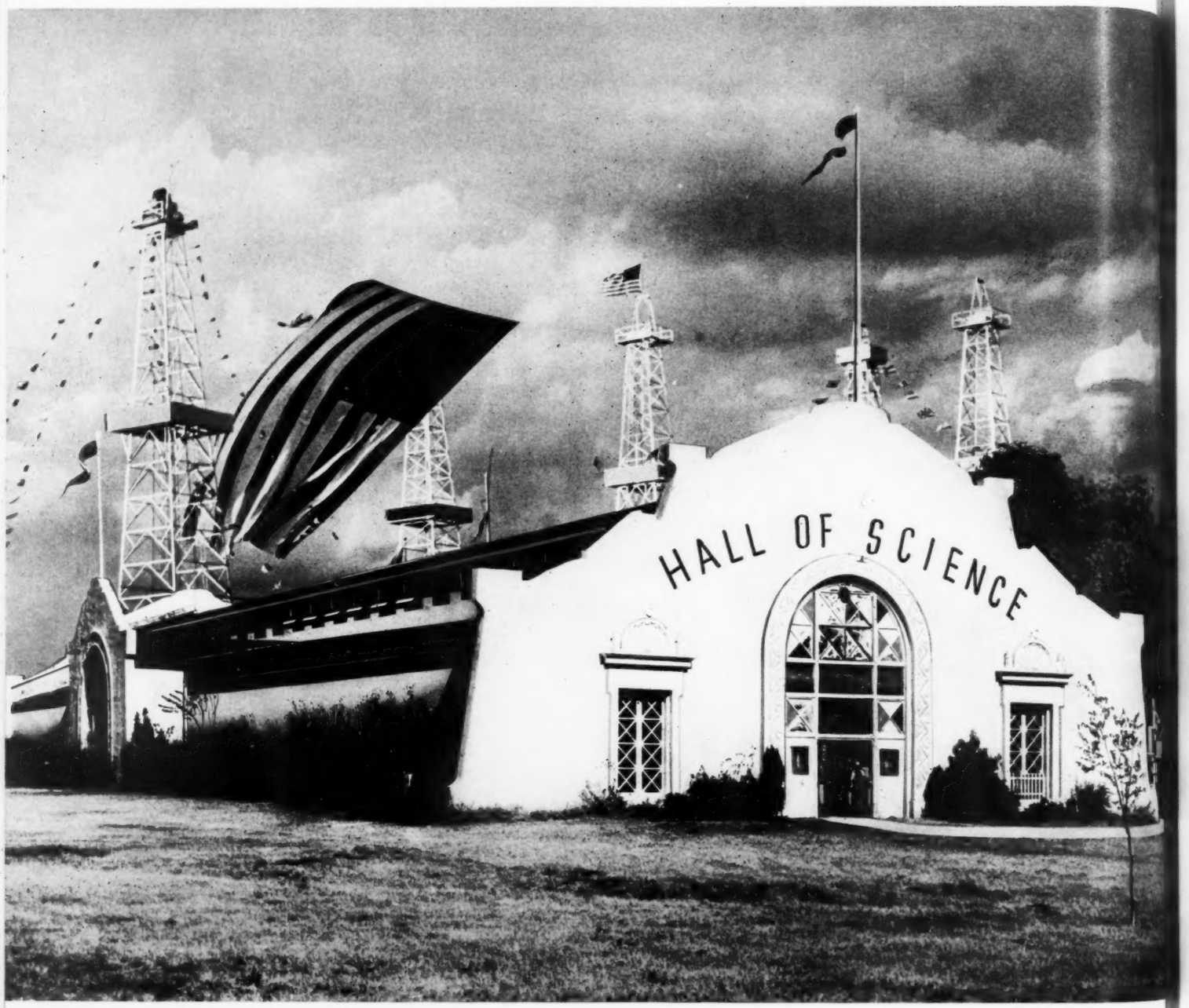

"The Progress of the Petroleum Industry from the Drake Well to 1940" is the theme of the exhibits to be seen in the Hall of Science at the Eleventh International Petroleum Exposition in Tulsa. The building will house permanent scientific and technical exhibits of the oil industry, and will be open to oil men and the public at all times.

EDITORIAL

OIL EXPOSITION'S SERVICE TO THE INDUSTRY

Every exposition claims to be educational and in truth most of them are. Even where instruction is heavily diluted with entertainment and emphasis is placed rather on thrills than on useful information only the hopelessly moronic fail to glean some useful information. Few indeed are those who can visit a well ordered display of the accomplishments of science, invention, skill and industry without acquiring new and stimulating knowledge about the progress of the world we live in.

If this be true of those miscellaneous displays which assume the grandiose title of world's fairs it applies in far greater degree to specialized exhibitions which present the picture of progress in a single industry or group of related industries. So well recognized is this that the great power shows, automobile shows, chemical shows and other merchandise displays have come to be established institutions drawing together by the hundreds of thousands serious minded persons who find these gatherings an essential means of keeping pace with new developments in matters that closely touch their daily interests and means of livelihood.

In no other field of activity is the fundamental value of periodic expositions more clearly shown than in those devoted to the petroleum industry. In earlier days some of its members may have looked upon an oil show as primarily an opportunity to get out with the boys from other fields, near or far, and have a good time. The reminiscent smiles of old timers when they discuss these early gatherings suggest that such was the case.

In twenty years, however, this attitude has completely changed. The progress of the oil industry is too rapid and the improvement in equipment too constant to permit the operators of the present day to treat their attendance at an oil exhibition as playtime. The International Petroleum Exposition which is to be held in Tulsa this month, for example, not only brings together a display of machinery as broad in its scope as the industry itself, but it also attracts a great concourse of business men who attend for purely business reasons.

These men come from all parts of the country and indeed from all quarters of the globe, not to amuse themselves but to be informed regarding the latest developments in the tools of their trade and the mechanisms by which their occupations and their incomes are governed to greater or less degree.

No better means of obtaining this essential information has been devised than that of bringing together in one place the newest and best that the manufacturers of oil industry equipment have to present. Inventions that have not yet been offered commercially will be on display. Improvements on time tested apparatus will be shown. The interested visitor can study and learn first hand about the practical application of devices that pertain to the particular branch of exploration, drilling or production with which he is concerned. The appeal is primarily educational and the procedure fundamentally informative.

Impressed by this phase of the exposition and with the desire to extend its instructional value WORLD PETROLEUM is devoting a large section of this issue to the presentation in word and picture of the characteristics, construction and operation of many of the new and significant things that are to be displayed at the exposition. It believes that the concise technical descriptions and explanatory illustrations will be useful to the operating men who attend the show and that they will serve a still broader purpose by conveying to the vastly greater number scattered about the world and unable to be present in person a clearer impression than they otherwise could obtain of some of the valuable features of the various displays.

Even though many pages are devoted to the subject space is lacking to portray everything of interest that will be shown. In some instances too the necessity of advance preparation of material prevented the inclusion of information and illustrations that could not be made ready in time. Certain exhibits naturally do not lend themselves to the scheme of treatment adopted. Within these limitations however the editors believe that the presentation in following pages will serve to carry a substantial part of the exposition's informative features to members of the oil industry, wherever they may be.

WAR'S EFFECT on U. S. Exports of Petroleum Products

Offsetting Decline in Shipments of Gasoline and Crude, Have Been Increased Demands for Lubricating Oils and Various Other Products — Isolation of Scandinavia Closes Important Markets.

EXTENSION of the European war area to Scandinavia seems likely to affect the petroleum industry in two directions. If, as appears probable, it marks the entrance of the conflict into a more active stage than it has assumed during the past several months it will result in a decided stepping up of oil consumption. Sea transport of troops with accompanying naval activity will require more fuel oil; attack and counter attack by air will use more aviation fuel, and the land movement of troops and supply trains will call for a more liberal use of gasoline and Diesel oil.

While military operations in Norway during the first few weeks of the struggle there have been on too small a scale to make serious draughts on existing fuel supplies, the more recent invasion of Holland, Belgium and Luxemburg clearly indicates a great extension of the war front in other directions and perhaps an intensification of the conflict on several fronts.

While too early too evaluate these recent developments one immediate consequence of Germany's seizure of Denmark and invasion of Norway will be a reduction of petroleum exports from the United States, already somewhat diminished by the earlier course of the war. Since Denmark, because of the German occupation, is classed as belligerent territory the allied blockade applies to it and will prevent the entry of petroleum supplies from the westward. The same conditions apply to Norwegian ports while they remain in German hands. Even though Sweden accomplishes the seemingly impossible by keeping the war outside its borders the difficulties of transportation presented by mines and naval patrols make the movement of products to that country by sea practically impossible. Thus the whole trade of the United States with the Scandinavian countries including Finland appears to be at an end for some time to come.

The importance of the trade with Scandinavia is indicated by the fact that in 1939 Sweden ranked second only to the United Kingdom in imports of gasoline from the United States, taking 3,331,368 bbl. Sweden also ranked eighth in imports of American crude while Denmark was among the ten most important purchasers of light fuel oil. Out of a total yearly consumption of between 20,000,000 and 25,000,000 bbl. of petroleum products in Scandinavia the United States supplied something over 10,000,000 bbl.

Of the North European group Sweden, by reason of its population and industrial development was the chief importer of American petroleum products. Its imports from the United States of six principal products in 1939 amounted to over 6,000,000 bbl. Denmark ranked second with imports of 2,834,000 bbl. and Norway came third with 1,290,485 bbl. Finland's requirements are relatively small but the country has been a steady purchaser of lubricating oils from the United States and last year took substantial quantities of gasoline. One of the important European markets for American petroleum products in the past has been Germany. Shipments to that country ceased last September with the establishment of the allied blockade. In the eight months of 1939 preceding September, Germany took over 6,000,000 bbl. of petroleum products and was among the leading purchasers of light fuel oil and lubricating oils. Two other very important markets were Holland and Belgium and while shipments to these countries have continued up to the present time they have been limited by shipping conditions and by the restrictions placed upon consumption and may now cease altogether.

TABLE I

U. S. Exports by Products

(In Bbl. of 42 U. S. Gallons)

	1939	1938	1937
Crude	72,063,824	72,271,699	67,126,877
Natural Gasoline	4,110,896	6,113,676	3,738,324
Aviation Gasoline	4,000,801	*	*
Other Gasoline	34,076,679	41,702,397	32,096,139
Kerosene	7,994,124	7,261,555	8,663,734
Light Fuel Oil	30,618,297	28,295,875	28,993,103
Residual Fuel Oil	14,972,045	15,536,286	12,810,012
Lubricating	11,864,881	9,312,305	10,899,368
Other Product	4,555,775	3,231,697	3,498,614
	184,257,322	183,725,495	167,826,181
Bunkers—U. S.	14,532,851	14,217,408	17,234,388
" —Foreign	22,502,837	21,841,787	20,453,907
	37,035,688	36,059,195	37,688,295

*Aviation fuel not separately reported before 1939.

Practically all the neutral countries of Europe have sought to cut down the consumption of motor fuel within their borders either by rationing or by the imposition of heavy taxes. In France and Great Britain the limitations placed on the use of motor cars by the civil population have more than offset increased demands for military use. Some time ago a report by French army authorities stated that the consumption of motor fuel during the first three months of the war had been only 25 percent of the quantity estimated as needed. Thus it has happened that the heaviest decline in U. S. exports has been registered in shipments of gasoline, the product which at the commencement of the war was expected to be most in demand.

TABLE II

U. S. Exports of Petroleum Products

(Bbl. of 42 U. S. Gallons)

	Sept. 1938 March 1939	Sept. 1939 March 1940	Percent Inc. or Dec.
Crude	37,095,648	35,424,414	− 4.5
Gasoline	28,696,384	19,744,093	−30
Kerosene	4,363,182	3,940,711	− 9.6
Light Fuel Oil	14,783,364	14,308,108	− 3.2
Residual Fuel Oil	9,219,512	6,925,153	−24.8
Lubricating Oil	5,252,491	7,767,638	+49.8
Other Products	2,132,420	3,442,962	+61.8
	101,543,001	91,553,079	− 9.8

Because the history of the first world war has failed to repeat itself and the great expansion in European purchases of American petroleum products thus far has failed to materialize there is a general impression that exports from the United States have fallen into a decided slump. This view is not supported by official statistics of the U. S. Department of Commerce covering the first seven months of the war, from September 1 to March 31. Comparison with the seven months immediately preceding would be misleading since shipments usually are heavier during the summer than in the winter months. In Table II accompanying, exports of all principal petroleum products for the first six months of the war period are shown in parallel with the corresponding months one year earlier. This table shows that the decline in total volume under war conditions was a little less than 10,000,000 bbl. or 9.8 percent.

While there was a shrinkage of 30 percent in exports of gasoline, of nearly 25 percent in residual fuel oil and of 4.5 percent in crude these losses were in part offset by an increase of 48 percent in shipments of lubricating oils and of roundly 62 percent in "other products". Among these other products which have felt an increased demand since the outbreak of war have been lubricating greases and wax, both of which are required in large volume for war purposes and by the accompanying speed up in industrial operations.

The future movement of American exports of petroleum products will depend upon the course taken by the war itself. With the intensification of military and naval operations which is now taking place, and should the war be extended to the Balkans and the Mediterranean, the need of additional petroleum supplies and the necessity of utilizing tanker tonnage to the best advantage undoubtedly will dictate a larger dependence by the allied nations upon South America and the United States. Compared with the long voyage around Cape of Good Hope from the eastward the trip from the Caribbean or the Gulf of Mexico represents a saving of over 75 percent in mileage and an even greater gain in tanker efficiency.

OIL MACHINERY EXPORTS Maintained High Level in 1939

Exceeded in Total Value Only in 1938—War's Effect Felt in Final Four Months—Countries of Near and Far East Take Place Among Leading Purchasers of Equipment.

OUTBREAK of war in Europe led to a slackening of oil machinery exports from the United States during the final four months of 1939. The decrease was more pronounced in the case of refining machinery than in drilling equipment. The average movement of both classes of machinery was approximately 30 percent less during the period September-December, inclusive, than during the earlier months of the year.

Apparently the easing off of shipments was a temporary development. Reports from oil companies engaged in development and operation in countries outside the United States indicate that they have not abandoned any of their plans for drilling or construction although in some instances work has had to be postponed beyond the date when it originally was scheduled. Disorganization of shipping at the beginning of hostilities, delays in effecting deliveries and in some countries exchange difficulties are the principal reasons given for such postponements as have occurred. While considerable publicity was given a few months ago to the fact that American engineering firms were compelled to suspend work on certain refining installations abroad because of pressure by the American government it is pointed out that these were isolated cases. For the most part any delay in projected undertakings at the present time simply means an added volume of business as soon as conditions become more nearly normal.

TABLE I accompanying shows the movement of exports month by month during 1939 and clearly reveals the influence of the war during the final third of the year. The statistics are those of the United States Department of Commerce. Like all figures relating to this subject they do not cover all equipment and supplies exported for the use of the oil industry but only such as are classified under the headings of drilling and refining machinery.

Even with the deterrent effect of the war during four of the twelve months of 1939 the total value of oil machinery exports was greater than in any preceding year except 1938. TABLE II gives the annual exports from 1931 to 1939 inclusive during which period they have amounted to over $180,000,000.

TABLE I

U. S. Exports of Oil Machinery 1939

	Drilling Machinery	Refining and other Equipment	Total
January	$1,707,582	$1,021,543	$2,729,125
February	1,637,342	1,687,239	3,324,581
March	1,824,232	2,307,964	4,132,196
April	2,155,217	1,800,995	3,956,212
May	1,487,184	1,695,127	3,182,311
June	1,554,142	1,940,373	3,494,515
July	1,439,628	1,678,508	3,118,136
August	1,640,085	1,719,754	3,359,839
September	1,621,314	1,041,222	2,662,536
October	1,712,565	651,022	2,363,587
November	1,259,307	638,828	1,898,135
December	1,758,826	943,026	2,701,852
	$19,797,424	$17,125,601	$36,923,025

TABLE II

Nine Year Record of Oil Machinery Exports

Year	Drilling Machinery	Refining and other Equipment	Total
1931	$3,557,259	$6,771,845	$10,329,104
1932	1,680,271	2,741,247	4,421,518
1933	2,692,279	4,221,678	6,913,957
1934	6,138,510	6,871,650	13,010,160
1935	6,745,208	8,054,182	14,799,390
1936	8,762,253	10,065,558	18,827,811
1937	18,513,062	16,671,459	35,184,521
1938	23,222,435	17,219,920	40,442,355
1939	19,797,424	17,125,601	36,923,025
	$91,180,701	$89,743,100	$180,851,801

During 1939 as for several years past Venezuela occupied the leading position among the purchasers of oil machinery from the United States. Netherlands India retains second place by virtue of the rapid expansion both of drilling and refining activities in that area. Argentina moved up into third position, followed by Netherlands West Indies and Colombia. Large exports went to Palestine in connection with the erection of a new refinery at Haifa which also is a port of entry for drilling equipment employed in Palestine and neighboring countries. Exports of over $2,000,000 of machinery to British India and Burma reflected the activity under way in those countries in exploration, drilling and refinery improvement. TABLE III lists the ten leading importers of American equipment during 1939. Other countries with purchases during the year ranging downward from a million to half a million dollars were Egypt, Australasia, Saudi Arabia, Iran and British Malaya.

Broadly speaking there are four grand divisions served by the exporters of American oil machinery. The most important of these is South America. Last year the countries of that continent took 45 percent of all such exports. The Near and Far East took respectively 22 and 19 percent leaving 14 percent for the rest of the world including Europe, Africa and North America. While there is more or less fluctuation from year to year in the imports of various regions according to the extent of their activities, the volume of this business has shown a continuous and rapid growth during the past decade. TABLE IV lists some of the countries that have ranked among the leading markets for American oil machinery with the amount of their purchases during the past six years.

TABLE III

Principal Purchasers of U. S. Oil Machinery

Country	Value
Venezuela	$5,382,861
Netherlands India	4,345,787
Argentina	3,173,380
Netherlands W. Indies	2,993,106
Colombia	2,828,925
Palestine	2,679,700
British India and Burma	2,197,860
Trinidad	1,637,784
Canada	1,568,650
Japan and Kwantung	1,004,061
Other	9,110,911
Total	$36,923,025

TABLE IV

Exports of Oil Machinery by Countries 1934-1939

Country	Value
Venezuela	$27,908,156
Netherlands India	16,824,341
Netherlands West Indies	14,309,933
Trinidad	9,876,692
Colombia	7,818,857
Iran	5,856,203
All others	76,590,240
	$159,184,422

Tide Water Associated To Install Houdry Unit

TIDE WATER ASSOCIATED Oil Company announced late in April that it had taken a license from the Houdry Process Corporation for a catalytic refining unit with a capacity of 15,000 bbl. per day. In connection with the taking of this license Tide Water Associated Oil Company has awarded a contract to E. B. Badger & Sons Company for the design and construction of the unit which will be located at the company's refinery at Bayonne, N. J., and will replace older facilities.

The company has also recently installed at its refinery in Avon, Cal., additional cracking facilities and a polymerization plant for the production of gasoline of high anti-knock value and improving its straight run gasoline and at present has in course of construction an alkylation plant at Avon for the purpose of making higher octane gasoline of aviation specifications.

The new unit at the company's Bayonne refinery will be completed and in operation toward the latter part of this year.

DANUBE—Europe's Vital Artery of Commerce

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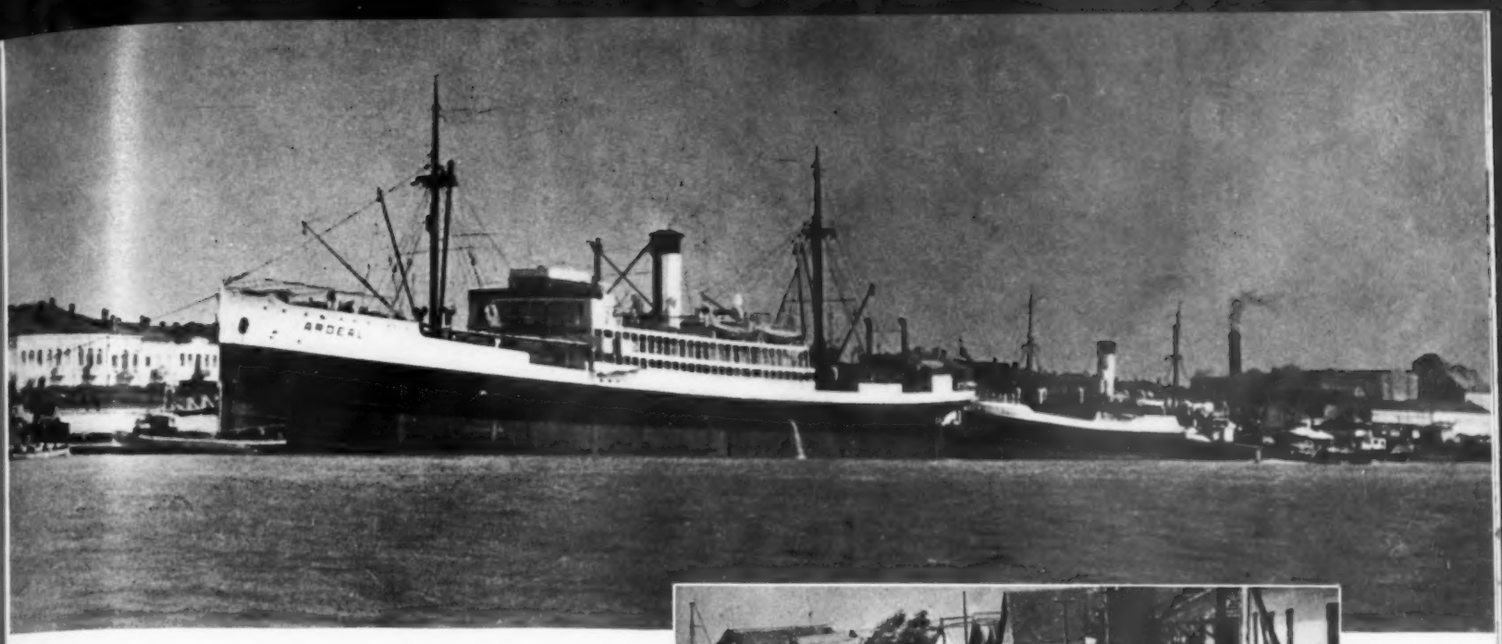


"The nation that controls the Danube from its source to its outlet would become the greatest power in Europe, and might become the greatest power in the world" said Dorothy Thompson in a recent article on this river in the New York Herald Tribune. Rising in the Black Forest of Germany, it flows through Europe's richest section, 1,750 miles through four countries with 45,000,000 in population within its fertile basin, through the narrow defiles of Kazan, through the Iron Gates and near the oilfields of Roumania till it finally discharges through seven channels in the thousand square mile delta into the Black Sea.

At left above the map shows the course of this mighty river that has become of vital importance to Europe at war. Up the river barges carry Roumanian oil and Hungarian wheat to the industrial centers of Germany—and for Germany, this oil is all-important. On its continued shipment in quantity may depend the continued neutrality of Roumania. The river is vulnerable in several spots, notably the Kazan defile and the Iron Gates. It is just above the Iron Gates that the Island of Ada-Kalad lies in the stream, inhabited solely by Turks who settled there during the Napoleonic Wars and it is this island that was believed the destination of the fifty-two men under command of British officers who were seized by Roumanian authorities recently, when a cargo of dynamite, a field piece and other arms were found on their vessel, the Thermonde. Now the river is closely guarded by the police of the countries along its banks.

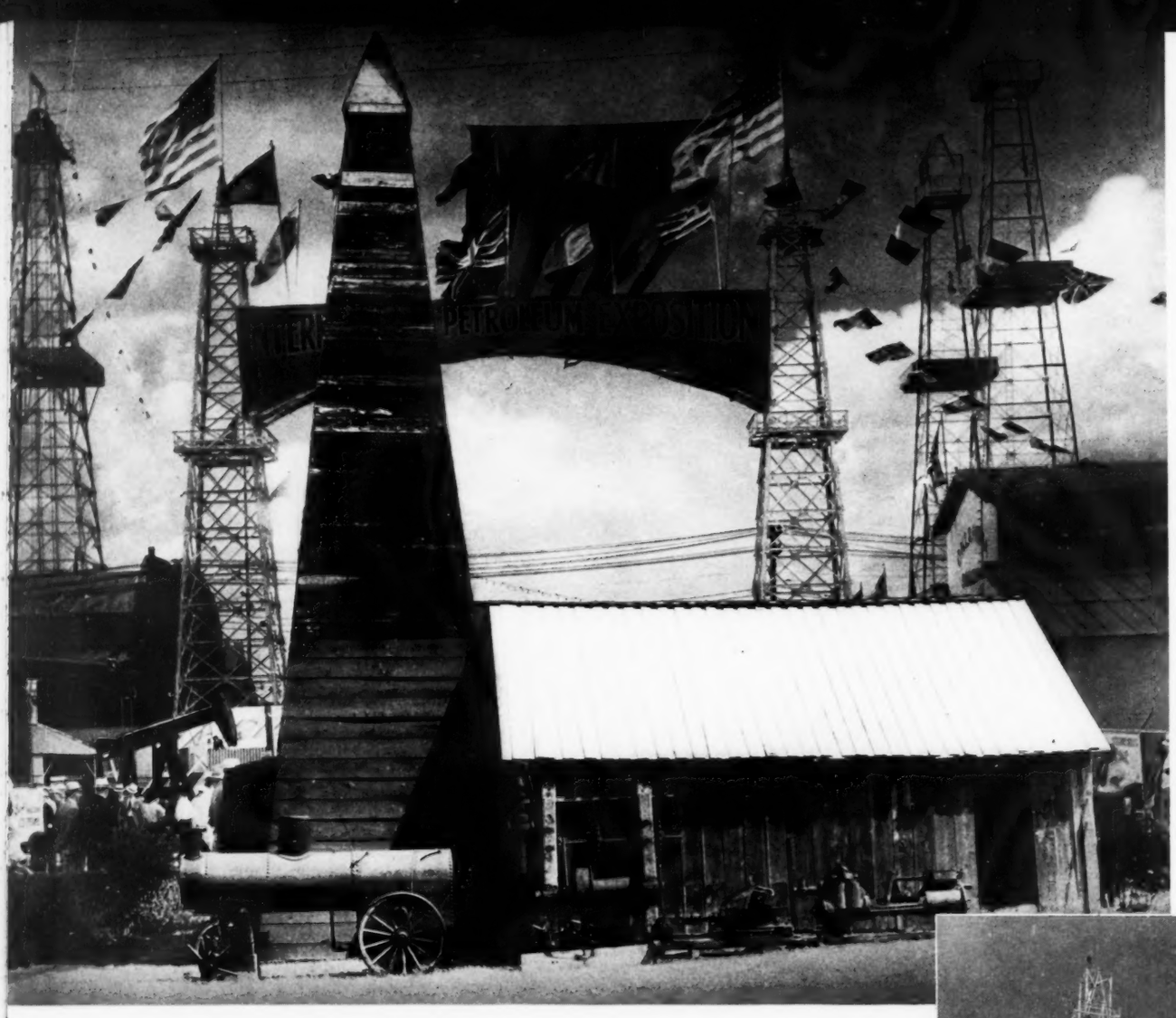
On the opposite page also is pictured the famous railway bridge which carries the Orient Express across the river on its way to Istanbul and the East. On the top of this page two English ships are seen loading wheat in the Roumanian port of Galatz, a phase of the intense economic war between England and Germany for control of the products of the 300,000 sq. mile Danubian basin. In the center of this page, native boats on the main channel of the marshy delta where the Danube empties into the Black Sea. At bottom, oil barges at the junction of the Sava and Danube in Yugoslavia—oil is one of the principal products transported on the river.

Will Germany send her troops down the Danube valley to the rich Hungarian granary and the oil fields of Roumania? The fate of these two countries as well as Yugoslavia and Bulgaria, perhaps all of Europe depends on this question. It has been suggested that Roumanian wells would be destroyed if the Germans marched in — but production in Roumania is declining and a smaller share is going to the Reich than the war machine may now require.

Dubrovnik in Yugoslavia near the junction with the Danube may be seen on the left, while on the right, a view of Budapest from the former Citadel on Szent-Gallert Hegy, 400 ft. above the river. Looking north, Buda lies on the left and Pest on the right hand side of the river. Photographs copyrighted by British Combine, Ltd.

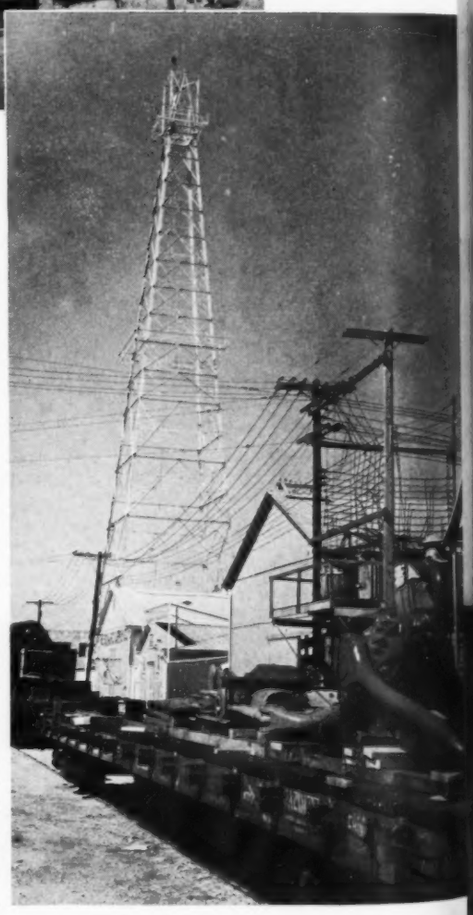
From the river may be seen (left) the House of Magnates and the House of Representatives flanking the 265 ft. dome of the Hungarian Parliament building on the Pest bank of the Danube at Budapest. On the right oil barges are tied up to the bank of the river at Dschurscheva. Directly below lies the city of Belgrade now the center of diplomatic tension in the face of European War. Photographs copyrighted by British Combine, Ltd.

German geologists are familiar with all the features of the Roumanian oilfields and the suggestion may be heard one day that German efficiency could boost Roumanian production as well as assure virtually the entire output for the Reich, if the barges are available to carry the oil up the river. On March 27th, one of the first river shipments of the year went up the river in a fleet of 30 barges each loaded with 600 tons of oil destined for the German army. The German monthly quota of 126,000 tons (which has not been filled yet) would require 210 barges each thirty days to make the round trip.



To serve as headquarters for "Old Timers" is the purpose of this clubhouse, a replica of the original Drake well, shown here with its exposition background of present-day equipment. The activity of the Old-Timers committee for the exposition has been extended to include the awarding this year of the title of "Grand Old Man" to representatives of each branch of the petroleum industry during a special ceremony.

Three carloads of equipment arrive at the grounds of the International Petroleum Exposition. This machinery is among the first to arrive at the grounds, and exhibits were being put in place a month before the opening date.

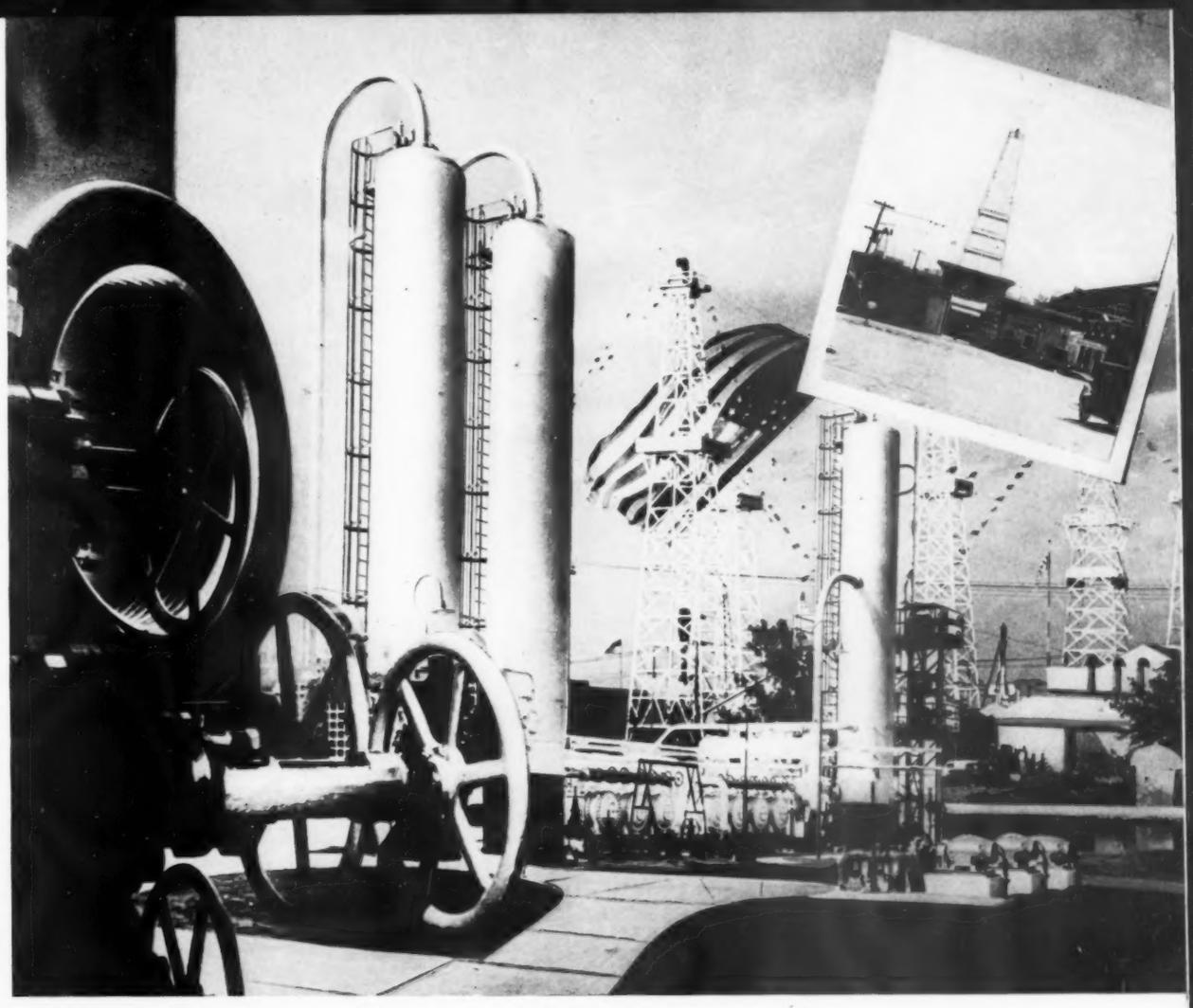


ENLARGED EXPOSITION
To Have Gala Opening at Tulsa

Started in 1923, Each Succeeding Exposition Has Attracted Wider Interest, While Equipment on Display Accurately Traces Development of the Oil Industry. International Aspects Stressed as Delegates Arrive from 25 Nations. Hall of Science Enlarged.

WHEN the Eleventh International Petroleum Exposition opens in Tulsa on May 18 there will be among the spectators of the opening ceremonies a handful of men whose minds must inevitably go back to that excessively rainy week in October 1923 when the first Tulsa oil show opened. It was only after months of effort on the part of Earl Sneed, who originally conceived the idea of an oil exposition, J. Burr Gibbons who promoted and managed the first show, H. O. McClure and William Holden both of whom acted on a committee appointed by the Chamber of Commerce to "determine the feasibility" of the show proposal. There were no aerial bombs to open the show. It occupied two blocks near the Tulsa convention. Some thirty exhibitors had equipment—very different from today's equipment—on display. And in a sense the dismal rain that poured down incessantly was responsible for the success of the show. Some foresighted committee member had taken out rain insurance!

These same men have seen the idea grow. The exposition was held in 1924 and 1925. It skipped 1926 but in 1927 it began to take on the form that it has followed since. Amuse-



These two views showing the first International Petroleum Exposition (inset) as contrasted with the last Tulsa show indicate the vast progress since the first exposition held in 1923. From a roped-off street area to a $750,000 plant site covering 25 acres is the record of progress made during the past 17 years.

ments were discarded, the show moved out to the present grounds and became almost entirely an opportunity for the equipment manufacturer to display his most recent developments to the oil operator.

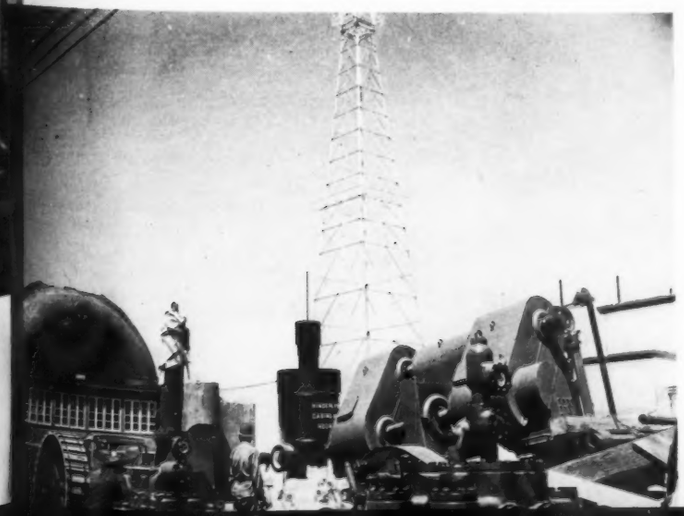
These same men must have seen the air tank blow up when Calvin Coolidge pressed a button that started a gusher from the replica of the Drake well—when the oil was exhausted the air tank that forced it to spout over the ancient derrick, blew up.

They have seen the exposition conclude a successful week a few days before the stock market crashed. They heard Robert Lamont open the 1930 Exposition with the now pertinent words:

"There is little that the government can do to overcome conditions. Help must come from within the industry."

Four years later, the industry was beginning to help itself from within when Harold Ickes, Administrator of the Petroleum Code under N. R. A., addressed the oil men gathered at the Exposition. William B. Way had become manager of the Exposition in 1929 and by 1938 the show had grown to 500 exhibitors, many of whom announced entirely new developments for the first time at the show.

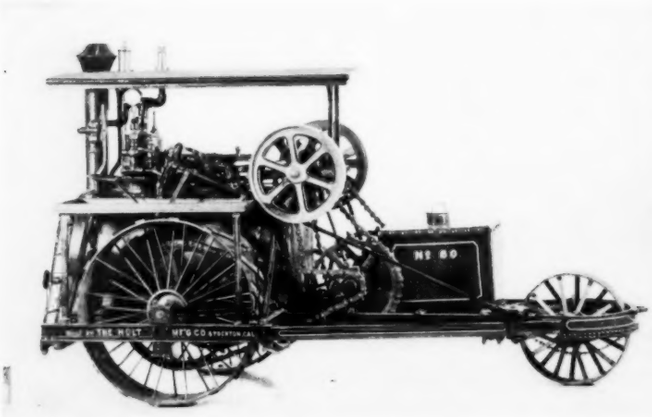
And now in 1940, the exposition opens with over 600 exhibitors, expecting a quarter of a million attendance, with fifteen to twenty million dollars worth of equipment on display, with a $750,000 plant covering 25 acres, six major exhibit buildings and thirty privately owned exhibit buildings, a Hall of Science which houses a permanent scientific display and representatives of more than 25 foreign nations attending. The international nature of the Exposition has become firmly established.

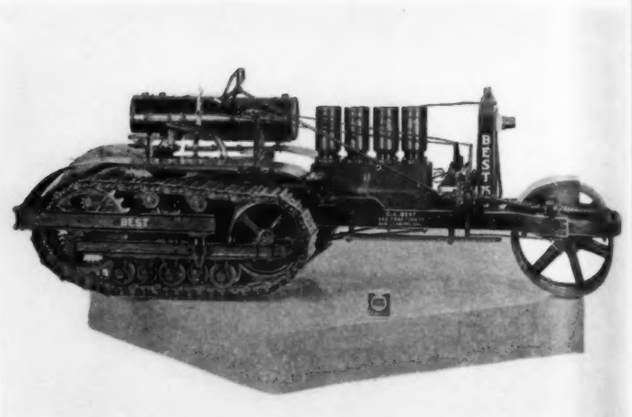


Some of the heavy equipment is shown here being placed in an exhibit for the Tulsa oil show. This equipment is part of a complete drilling unit which will actually make hole to demonstrate equipment in operation and to show visitors recent refinements in petroleum equipment.

This year for the first time there will be a special building on the grounds for the international delegates. The regular dinner for the representatives of foreign oil producing countries has become one of the outstanding events of the Tulsa show. There will be awards to those selected as Grand Old Men in each division of the industry. Safety features will be stressed throughout the week with final contests and awards. Special days will be dedicated to drilling contractors, to the production, refining, pipeline and marketing branches of the industry. A special day also will be devoted to purchasing agents as indeed it should; for it was while peering into a display window at the headquarters of the Tulsa Purchasing Agents Association 18 years ago that Earl Sneed conceived the idea of a great International Petroleum Exposition for Tulsa. There will be a special radio booth for broadcasts direct from the show, there will be broadcasts from planes flying over the grounds during the opening ceremonies. Perhaps no traces of oil will be discovered by enterprising exhibitors operating their equipment on the grounds as there were in 1938—but there will be thousands of words written about the show, about the new equipment announced for the first time, and about the new models in the Hall of Science.

And it must all be very gratifying to Sneed and Gibbons and the others who were concerned in putting over the 1923 show when the Tulsa merchants showed more enthusiasm





Heavy work in the oil industry is done by powerful tractors capable of going almost anywhere; true to the Exposition theme of showing equipment progress from the Drake well to the present day, there will be on exhibit models of tractors such as the above presented by Caterpillar Tractor Company. The model on the left, manufactured by Holt Brothers circa 1890; on the right a 1917 gasoline model made by G. L. Best.

than oil men or equipment manufacturers.

Particular attention will be paid by the thousands who attend the Exposition to the Hall of Science, which will include this year exhibits and displays of the progress of the petroleum industry since the time of the original Drake well, together with present-day laboratory testing methods which are being used to develop the oil industry's equipment for future years.

In exploration, for example, complete displays will describe the current methods of geophysical and geological research, in addition to such new methods as soil analysis and Gamma-ray exploration and well-logging.

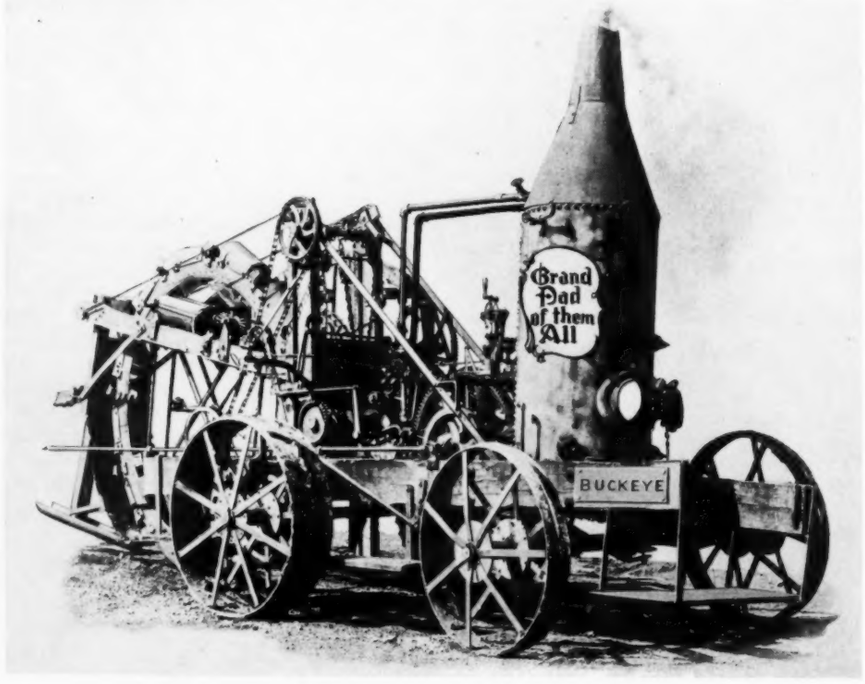
The Gamma-ray device is a method whereby wells may be logged through the pipe. Certain beds below the surface have a greater content of radioactive elements than others, and the iron pipe offers very little impediment to the Gamma-rays which are emitted by these radioactive elements. Consequently, the device is lowered in a well to detect and record the quantity of radioactive emission at each depth.

An exhibit of especial interest to men in the refining branch of the petroleum industry which will be seen in the Hall of Science will be one showing the evolution and development of return bends for tubular stills used in the processing of petroleum, the major portion of the development of which is attributed to the late Dr. Frederick E. Key.

In addition there will be a number of other exhibits in the Hall of Science, of interest to the oil man and to the layman. These will include safety displays, modern knock test engines, a Link trainer in operation, a geological cross section of the Illinois basin, precision instruments, aero exploration photos, models of equipment, acidizing equipment and a complete glass centrifugal pump shown in contrast with a 100-year old pump taken from actual service.

The advance program of activities is as follows:

Even prior to 1900 mechanical ditching was hastening pipelines across the country. Here is illustrated a 40-year old Buckeye ditcher, a far cry from the present modern Buckeye Traction Ditchers which are on display at Tulsa (as is this machine).



SCHEDULE OF EVENTS

SATURDAY, MAY 18

9:30 a.m.	Exposition gates open.
10:00 a.m.	Registration of "Old Timers" of Petroleum Industry in Replica of Old Drake Well, Exposition ground.
10:00 a.m.	Hall of Science opens.
2:00 p.m.	Opening Ceremony.
3:00 p.m.	Registration of International delegates, International Delegates building.
6:00 to 7:30 p.m.	Music in Cafe de Petrol. Special cinema showing in Hall of Science.
9:00 p.m. to 1:00 a.m.	Dining and Dancing, Cafe de Petrol

SUNDAY, MAY 19

3:00 p.m.	Ceremony dedicated to "Old Timers", Exposition grounds.
6:00 to 8:00 p.m.	Music in Cafe de Petrol.
7:30 p.m.	Special showing in Hall of Science.
9:00 p.m. to 1:00 a.m.	Dining and dancing in Cafe de Petrol.

MONDAY, MAY 20

All day.	Golf Tournament Practice Round.
8:00 p.m.	First performance, Oil Capitol Horse Show, Livestock Pavilion, just outside Exposition grounds.

TUESDAY, MAY 21

8:00 a.m.	Qualifying round, Golf Tournament.
9:30 a.m.	Exposition gates open.
10:00 a.m.	Young Executives Oil Men's Day, sponsored by Junior Chamber of Commerce.
12:00 noon.	Junior Chamber of Commerce, Young Oil Men's Luncheon. Chamber of Commerce dining room, Tulsa building.

H. C. Price Company is represented at the Show and one of the company's truck-mounted welding units is pictured above — the type that has travelled the jungles of South America welding the great oleoducts that are changing the flow of oil in international trade. Right: Directors and committee chairmen of the Exposition, left to right: William A. Schleuter, Phil Bohart, W. G. Skelly and Jay P. Walker.

2:00 to 4:00 p.m. Junior Chamber of Commerce Young Oil Men's Trip through the Mid-Continent Petroleum Corporation Refinery.

2:30 p.m. Trip to near-by oilfield for Seismographic demonstration through courtesy of Seismograph corporation.

7:00 p.m. International Delegates Banquet, Nomads Club members as hosts, Tulsa Club.

7:00 p.m. Petroleum Motor Transport Association Banquet. Hotel Tulsa.

7:30 p.m. Special showing in Hall of Science.

8:00 p.m. Oil Capitol Horse Show, Livestock Pavilion just outside Exposition grounds.

8:30 p.m. Junior Chamber of Commerce, Young Oil Executives Party.

WEDNESDAY, MAY 22

8:00 a.m. First round, Golf Tournament—18 holes.

12:00 noon. "Old Timers" luncheon.

12:00 noon. Luncheon for International Delegates to the International Petroleum Exposition at Hotel Tulsa. Sponsored by Rotary Club.

THURSDAY, MAY 23

8:00 a.m. Second and Third round, Golf Tournament—18 holes each.

9:30 a.m. All-day Safety Conference opens.

12:00 noon. Safety Conference luncheon.

12:30 p.m. "Old Timers" Luncheon at Exposition grounds, W. G. Skelly, Host.

1:30 p.m. Safety conference continues.

6:00 to 7:00 p.m. Informal Dinner, Purchasing Agents, Roof Garden, Tulsa Club.

7:00 p.m. Safety Banquet and Awarding of Safety Contest Prizes. Topaz room, Hotel Tulsa.

8:00 p.m. Oil Capitol Horse Show, Livestock Pavilion, just outside Exposition grounds.

FRIDAY, MAY, 24

9:00 a.m. Finals, Golf Tournament.

12:00 noon. Luncheon, Tulsa Chamber of Commerce, Special Exposition program for International delegates.

4:00 p.m. Awarding of Medals to "Old Timers," Exposition grounds.

SATURDAY, MAY 25

9:30 a.m. Exposition gates open.

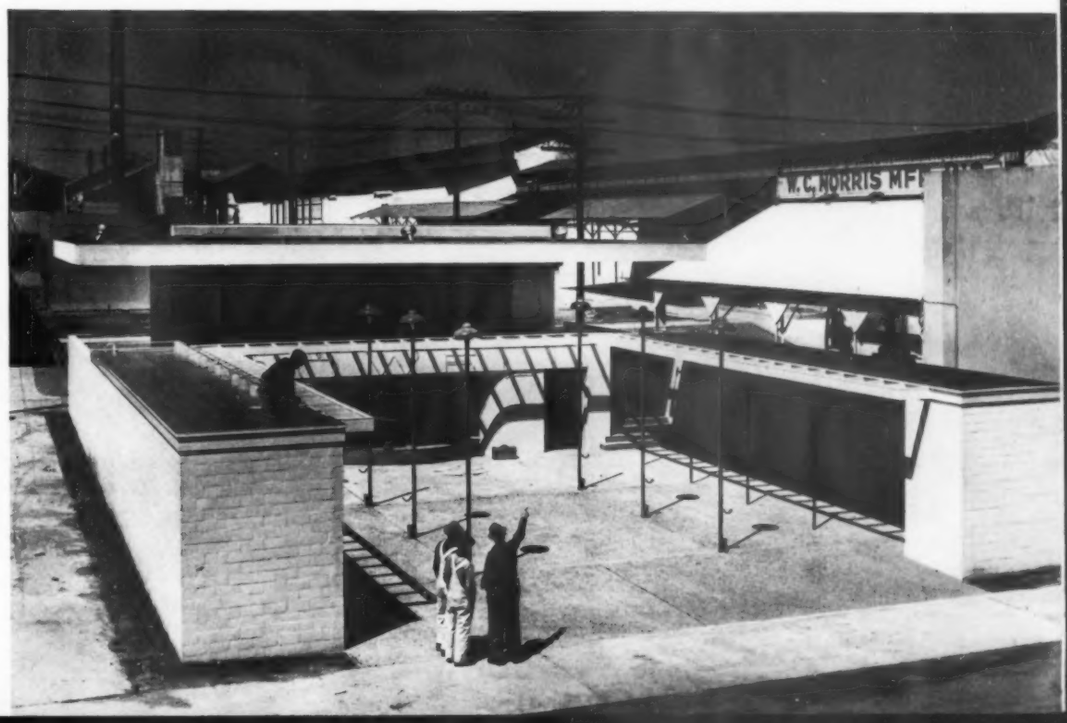
9:30 a.m. Registration of International delegates.

10:00 a.m. Hall of Science open—Movies all day.

8:00 p.m. Closing performance, Oil Capitol Horse Show, Livestock Pavilion just outside Exposition grounds.

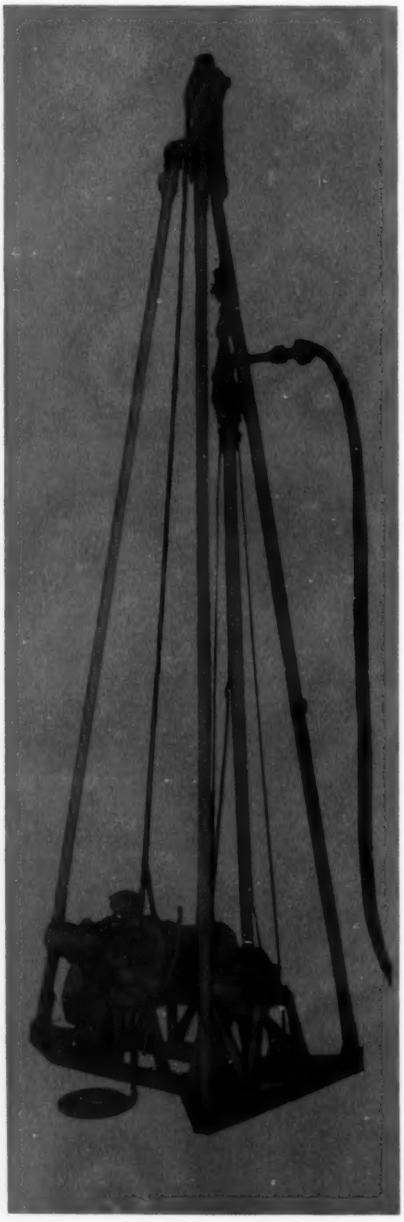
9:00 p.m. to 1:00 a.m. Dining and Dancing in Cafe de Petrol.

Construction of two story, cantilever roof building of modern design drawn up by Alden B. Dow for the Dowell Incorporated exhibit at Tulsa which will provide 3400 sq. ft. for the varied displays.



Latest Developments in Oilfield Equipment Displayed at PETROLEUM EXPOSITION

From oil fields in every quarter of the globe, oil men have come to Tulsa primarily to see for themselves what is new in equipment, what new methods, new tools, are available to increase the efficiency of their operations. It is this constant striving after the ultimate in efficiency that is responsible for the unchallenged supremacy of the men of Texas, Oklahoma and California in the art of finding, producing, transporting and refining the world's oil. WORLD PETROLEUM presents herewith the very essence of the International Petroleum Exposition being held at Tulsa. On this and the following forty-eight pages some part of the information that these men seek is set forth; on these pages appear illustrations and descriptions of much that is outstanding in equipment development during the recent past.

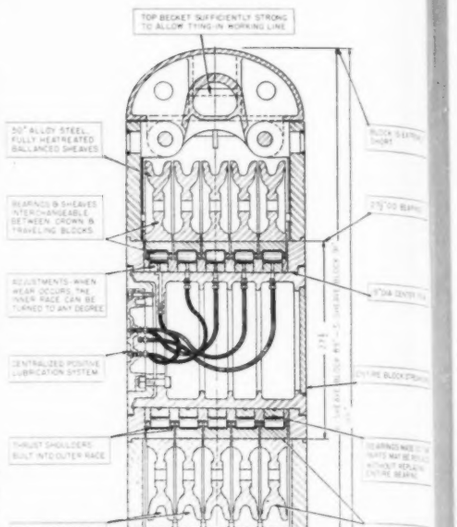


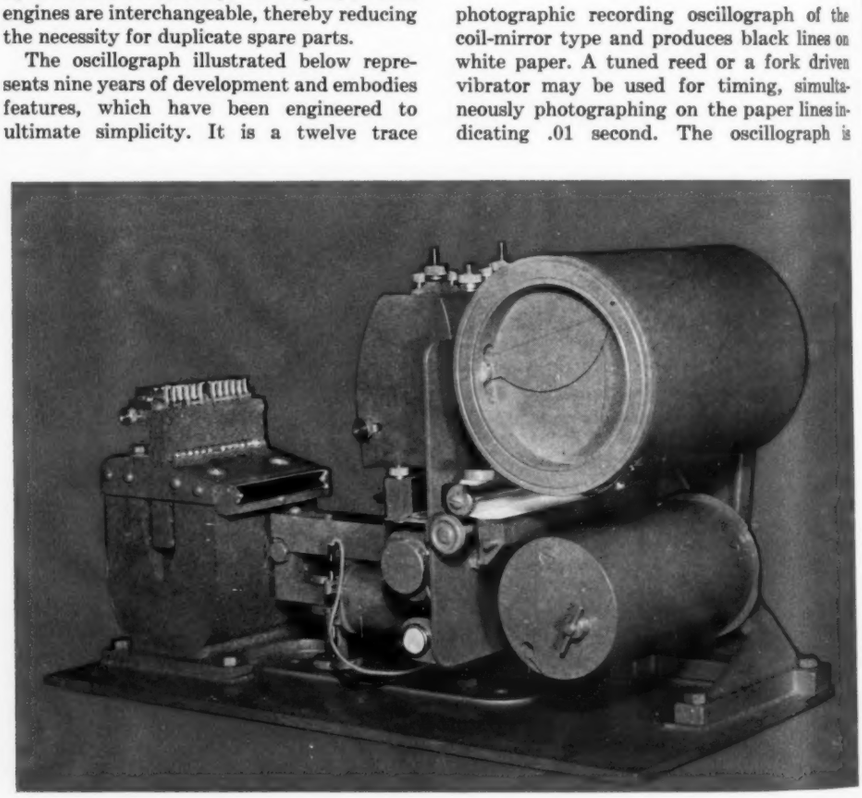
To secure extreme portability, permitting convenient transportation over mountainous and swampy terrain and at the same time to have a drill capable of 250 to 300 ft. in hard and sticky formations, Seismograph Service Corporation has developed the rotary shot hole drill pictured at left. The unit may be assembled from parts which do not weigh over 103 lbs. in any one case.

The rotary table and draw works, as well as the mechanical pull-down device, are driven by a five horse power air-cooled engine, which provides ample power.

The mud pump is a modified Moyno type pump, providing ample pressure and volume for the "A" rod used. The pump is also driven by a similar five horse-power engine, so that engines are interchangeable, thereby reducing the necessity for duplicate spare parts.

The oscillograph illustrated below represents nine years of development and embodies features, which have been engineered to ultimate simplicity. It is a twelve trace photographic recording oscillograph of the coil-mirror type and produces black lines on white paper. A tuned reed or a fork driven vibrator may be used for timing, simultaneously photographing on the paper lines indicating .01 second. The oscillograph is

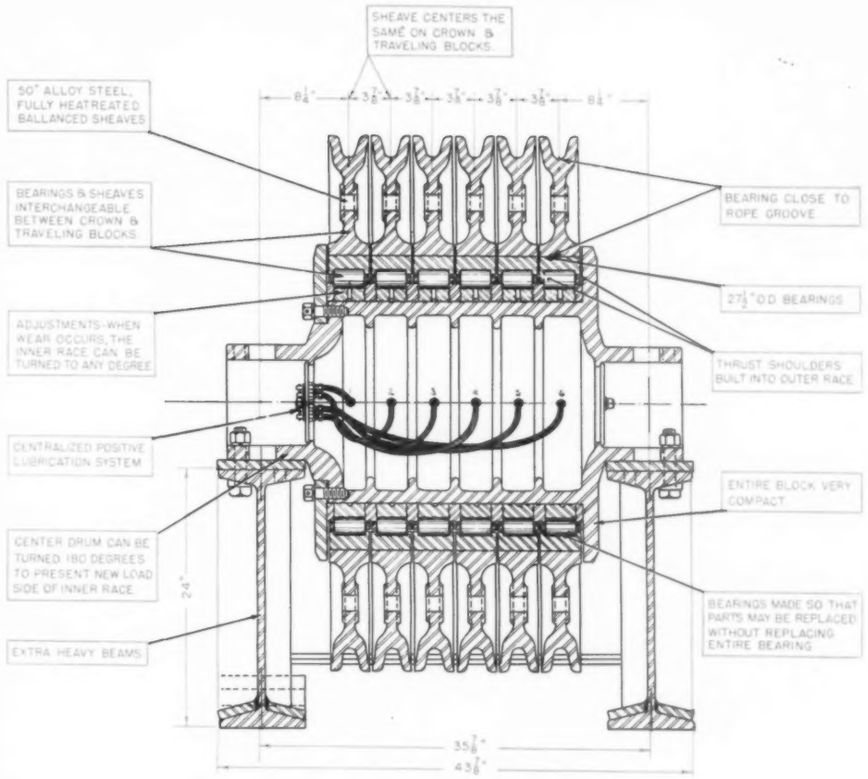

TOP BECKET SUFFICIENTLY STRONG TO ALLOW TYING IN WORKING LINE
50" ALLOY STEEL FULLY HEATREATED BALANCED SHEAVES
BEARINGS IN SHEAVES INTERCHANGEABLE BETWEEN CROWN & TRAVELING BLOCKS
ADJUSTMENTS-WHEN WEAR OCCURS, THE INNER RACE CAN BE TURNED TO ANY DEGREE
CENTRALIZED POSITIVE LUBRICATION SYSTEM
THRUST SHOULDERS BUILT INTO OUTER RACE
SHEAVE CENTERS THE SAME ON CROWN & TRAVELING BLOCKS
ENTIRE BLOCK VERY COMPACT
FORGED STEEL QUICK OPENING STREAMLINED POSITIVELY LOCKED LOWER CLEVIS



electric motor driven with a precise governor control, so that paper speeds are uniform. A relay is controlled by the starting switch, so that during the relatively short time the oscillograph is in operation, extra illumination is provided. This allows the oscillograph lamps to be on for quite long periods at reduced brilliance, enabling the operator to make adjustments and see the lines on the film before actually running the film and taking records.

Both the drill and the oscillograph constitute outstanding features of the seismic equipment which will be exhibited.

The drilling of deeper and deeper wells has created a demand for larger sheaves in crown and travelling blocks with the result that wider bearings are required in order to eliminate tilting and to give greater carrying capacity. However, this trend as regards conventional design resulted in slowing down operations, restricting pipe racking space or in preventing the full height of the derrick being utilized. To overcome these difficulties, Emsco Derrick and Equipment Company has designed and are exhibiting at the International Petroleum Exposition at Tulsa the travelling block illustrated in diagramatic form on the opposite page and the crown block illustrated at right. These are known as Series M-50 and by the use of 50 in. fully heat treated and balanced sheaves saves wire line. Greater strength is assured by the 19 in. diameter center drum while the 27½ in. O.D. bearings provide long life. The bearings are set close to rope grooves which prevents tilting and consequent wear on bearing and sheave. Parts are interchangeable cutting down on investment in spare parts while operations are speeded up by the extreme narrowness of the blocks. Economy is also achieved by the design of the block in such a manner that parts may be replaced without replacing entire bearing. The travelling block is extremely short permitting utilization of the maximum height of the derrick.


SHEAVE CENTERS THE SAME ON CROWN & TRAVELING BLOCKS
50" ALLOY STEEL, FULLY HEATREATED BALLANCED SHEAVES
BEARINGS & SHEAVES INTERCHANGEABLE BETWEEN CROWN & TRAVELING BLOCKS
ADJUSTMENTS-WHEN WEAR OCCURS, THE INNER RACE CAN BE TURNED TO ANY DEGREE
CENTRALIZED POSITIVE LUBRICATION SYSTEM
CENTER DRUM CAN BE TURNED 180 DEGREES TO PRESENT NEW LOAD SIDE OF INNER RACE
EXTRA HEAVY BEAMS
BEARING CLOSE TO ROPE GROOVE
27½" O.D. BEARINGS
THRUST SHOULDERS BUILT INTO OUTER RACE
ENTIRE BLOCK VERY COMPACT
BEARINGS MADE SO THAT PARTS MAY BE REPLACED WITHOUT REPLACING ENTIRE BEARING
24"
35 7/8"
43 7/8"

The Emsco travelling block illustrated on the opposite page has a capacity of 325 tons based on yield with a factor of two. The sheaves are 50 in. in diameter while the center drum is 19 in. in diameter. The side plates are two inches thick and the bearings are 23.206 in. diameter. The block is not only narrow but short being only 101 in. overall and 24¼ in. in width overall. The weight varies from 10,740 lb. when grooved for the 1¼ in. line to 10,805 lb. when grooved for the 1⅛ in. line.

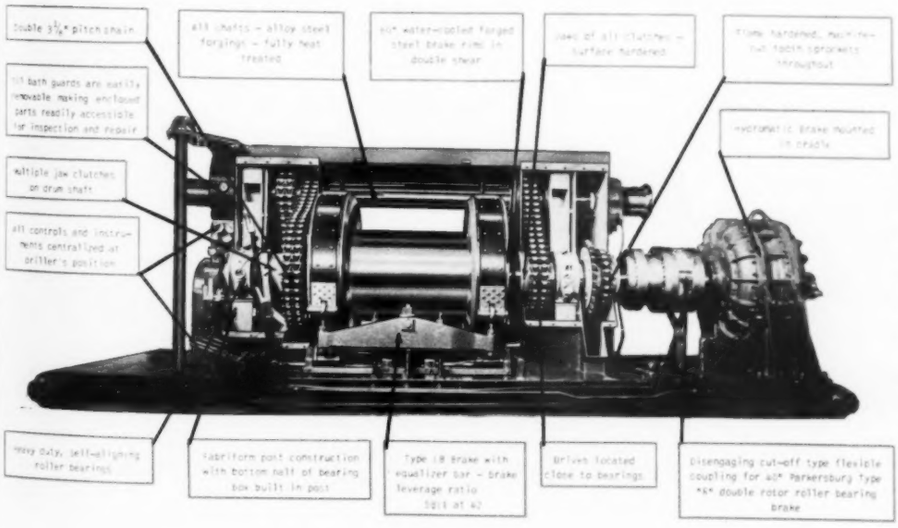
The crown block illustrated above is 43⅞ in. wide by 55¼ in. high by 96 in. long overall, weighs 9,545 to 9,625 lbs. and has a capacity of 360 tons based on yield with a factor of two. It is grooved for the 1⅛ or 1¼ in. line, has a center drum diameter of 19 in. bearings of 23.206 in. and sheaves of 50 in. diameter.

The most recent Emsco draw works are illustrated below and are of the largest and heaviest type available, designed for the most severe service. These drawworks incorporate a number of new features.

Due to greater depths being drilled in the past few years, necessitating larger and heavier drawworks and resulting in more massive parts, the bearing centers—in attempting to stay with the conventional design of drawworks—have had to be increased, resulting in larger shafts to withstand the extreme loads imposed or sacrificing the factor of safety.

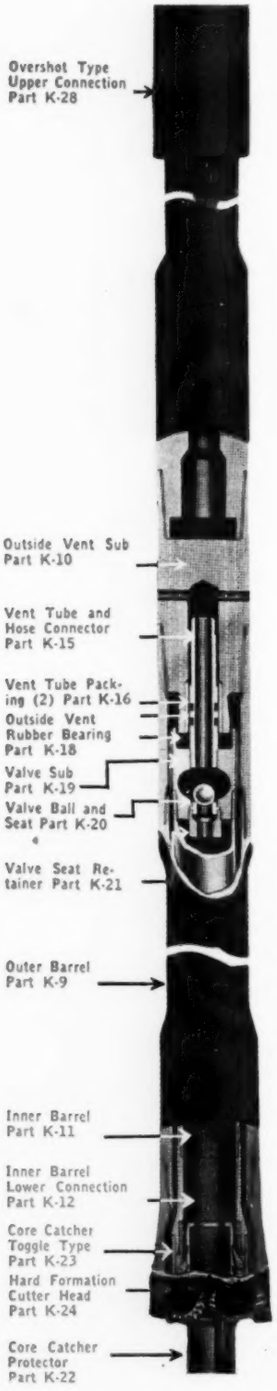
As the tendency is more and more toward concentrating as much of the manual cathead work as possible on the driller's side, in order to eliminate the hazard in operating the manual cathead on the rotary side, a hazard that has greatly increased in recent years due to the necessity of cluttering up the rotary side with a hydromatic brake and other equipment—it is more important than ever to keep the driller's side of the drawworks clear.

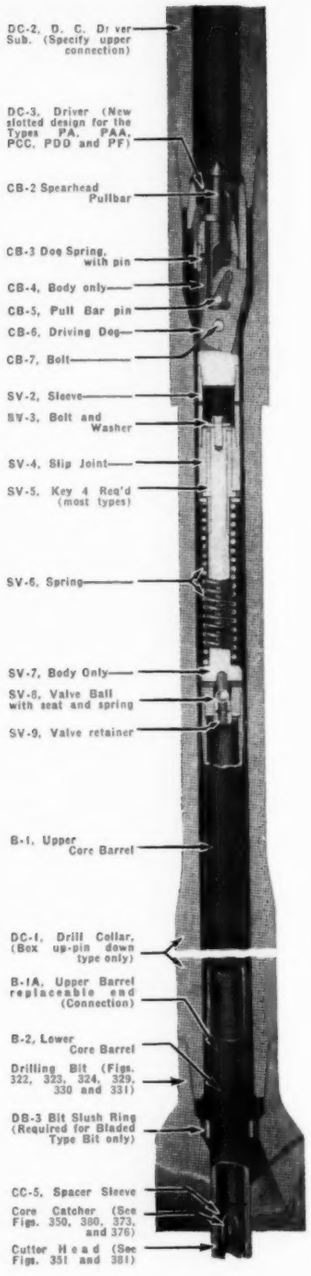
This problem has been solved in the Emsco drawworks illustrated by placing one of the drives from the jackshaft to the lineshaft outside the post on the driller's side, which results in materially reducing the bearing centers without in any way presenting a hazard to safety or impairing operating efficiency.


Double 3½" pitch chain
All shafts – alloy steel forgings – fully heat treated
60" water-cooled forged steel brake rims in double shear
Jaws of all clutches – Surface hardened
Three hardened, machine cut tooth sprockets throughout
Hydromatic brake mounted on operator's
All bath guards are easily removable making enclosed parts readily accessible for inspection and repair
Multiple jaw clutches on drum shaft
All controls and instruments centralized at driller's position
Heavy duty, self-aligning roller bearings
Fabriform post construction with bottom half of bearing box built in post
Type 18 brake with equalizer bar – brake leverage ratio 28:1 at 42
Drives located close to bearings
Disengaging cut-off type flexible coupling for 40" Parkersburg type "S" double rotor roller bearing brake

For large diameter cores, Reed Roller Bit Company has developed a conventional core drill known as Reed Kor-King incorporating a number of new features. This is illustrated below in a manner to give complete mechanical details of the working parts of the barrel and is being exhibited at the International Petroleum Exposition.

Among the several exclusive features of the Kor-King may be listed the choice of inside vent, outside vent or drop ball type in the same barrel; non-rotating inner barrel, operating against oil-proof, slush lubricated rubber bearings; and non-rotating (rust proof) core catcher.


Overshot Type Upper Connection Part K-28
Outside Vent Sub Part K-10
Vent Tube and Hose Connector Part K-15
Vent Tube Packing (2) Part K-16
Outside Vent Rubber Bearing Part K-18
Valve Sub Part K-19
Valve Ball and Seat Part K-20
Valve Seat Retainer Part K-21
Outer Barrel Part K-9
Inner Barrel Part K-11
Inner Barrel Lower Connection Part K-12
Core Catcher Toggle Type Part K-23
Hard Formation Cutter Head Part K-24
Core Catcher Protector Part K-22


DC-2, D. C. Driver Sub. (Specify upper connection)
DC-3, Driver (New slotted design for the Types PA, PAA, PCC, PDD and PF)
CB-2 Spearhead Pullbar
CB-3 Dog Spring, with pin
CB-4, Body only
CB-5, Pull Bar pin
CB-6, Driving Dog
CB-7, Bolt
SV-2, Sleeve
SV-3, Bolt and Washer
SV-4, Slip Joint
SV-5, Key 4 Req'd (most types)
SV-6, Spring
SV-7, Body Only
SV-8, Valve Ball with seat and spring
SV-9, Valve retainer
B-1, Upper Core Barrel
DC-1, Drill Collar, (Box up-pin down type only)
B-1A, Upper Barrel replaceable end (Connection)
B-2, Lower Core Barrel
Drilling Bit (Figs. 322, 323, 324, 329, 330 and 331)
DB-3 Bit Slush Ring (Required for Bladed Type Bit only)
CC-5, Spacer Sleeve
Core Catcher (See Figs. 350, 380, 373, and 376)
Cutter Head (See Figs. 351 and 381)

The non-rotating inner barrel of the core drill is made of one piece seamless steel tubing with a replaceable lower connection. This floating type inner barrel permits the core to enter without being broken apart or destroyed and is of material aid in the recovery of long, clean cores. The non-rotating inner barrel is plated against rust and operates against oil proof, slush lubricated rubber bearings. The usual bearing adjustments and frequent replacements are eliminated.

Core catchers for the core drill are of the non-rotating or floating type. This type core catcher eliminates the hazards of packing or binding of the core and prevents its destruction. Both toggle and spring type core catchers are available.

On the left is illustrated a wire line core barrel also developed by Reed Roller Bit Company for intermittent or continuous coring, incorporating a spring-loaded mechanism to regulate and control the protrusion of the core cutter head.

Exclusive features of this wire-line coring unit include the positive locking and releasing device for both the core barrel and center bit assemblies; replaceable core barrel cutter heads; large selection of size ranges; inside clearances to allow running of surveying instruments.

The spring-loaded mechanism is provided to regulate the load on the core cutter head so that too much weight of the drill pipe cannot be put on the core barrel assembly. The spring permits retraction of the cutter head into the drilling bit when the cutter head is first set on bottom, and allows the cutter head to core ahead of the drilling bit in soft formations. To protect the cutter head and core barrel from excessive weight, which is ordinarily experienced in drilling hard formations, the spring allows retraction of the cutter head to a maximum of three-quarters inch within a sharp drilling bit. The sectional drawing shown here describes in detail the complete working assembly of the Reed wire-line coring unit.

The wire line coring-drilling tool has a maximum opening through the drilling bit which allows the use of large surveying equipment. The retractable core barrel cutter head design makes possible the enlarged bore for large inside operating tools, resulting in more durable equipment and more accurate readings. Also, the surveying tools can be run on the same wire line as is used with the core barrel.

To eliminate the developing of photographic drift indicator records in solutions, the Eastman Oil Well Survey Company is manufacturing for distribution a new Type-M drift indicator which is radically different in design. It records on light-sensitive paper that can be loaded and unloaded in daylight. The instrument is small and compact and can be handled easily and quickly. It is illustrated at top of facing page.

The mechanism incorporates an arrangement whereby the inclination of the well is recorded by a strong light beam directed through the plumb-bob onto the light-sensitive paper printed with concentric circles each of which represents a degree.

The instrument is run into the well, in a new Eastman streamlined barrel, on piano wire, sandline or dropped to bottom just before drill pipe is pulled to change bits. The barrels are supplied with interchangeable connections for all operations and small enough to run through tool joints in 3½ in. regular API drill pipe.

Although not photographic in principle, the new drift indicator embodies the important advantage of the photographic method of recording and furnishes a positive reading when the instrument is on bottom and quiet.

FIGURE 1 "SEALTITE" DRILLING CONTROL SHOWING STORAGE FOR HOSE AND DIAPHRAGMS

FIGURE 3 "SEALTITE" WEIGHT INDICATOR WITH COVER REMOVED TO SHOW MECHANISM

FIGURE 4 BACK OF INDICATOR GAUGE SHOWING BRACKET FOR GAUGE AND PULSATION DAMPERS

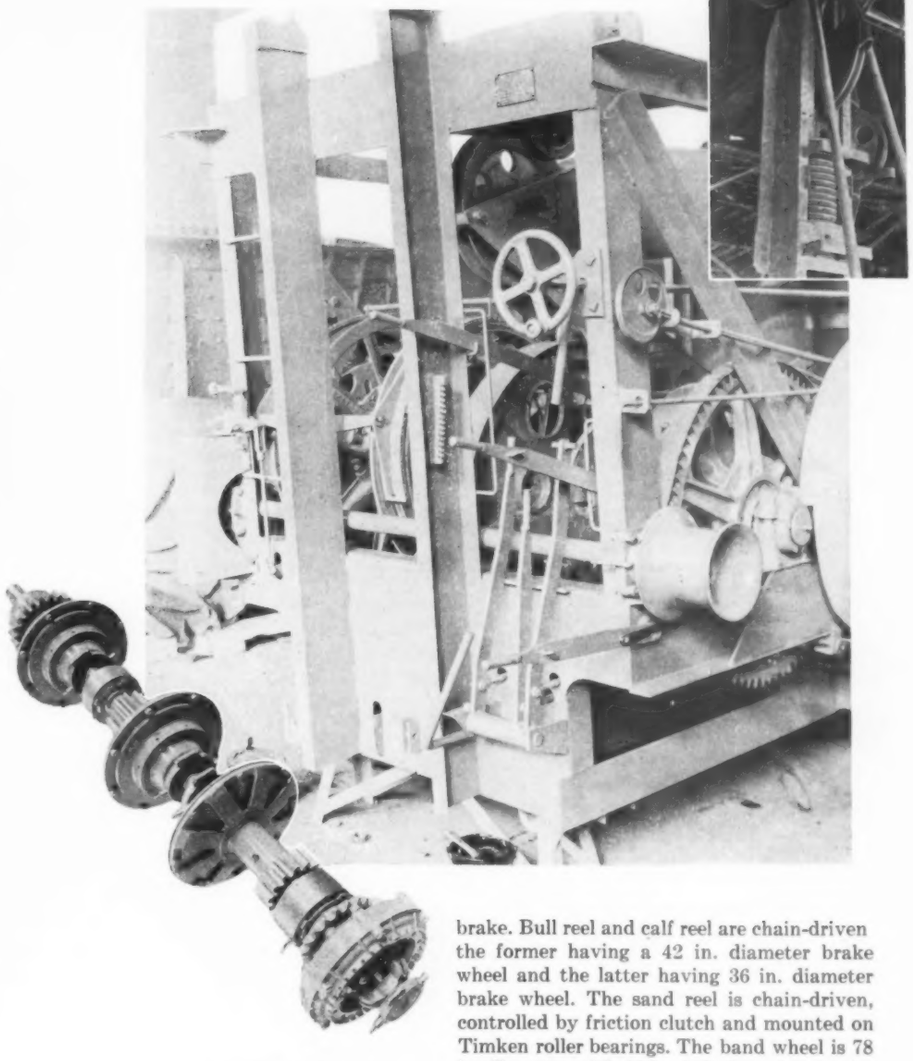
FIGURE 2 STEEL REINFORCED FLEXIBLE RUBBER HOSE WORKING PRESSURE 15,000 P.S.I.

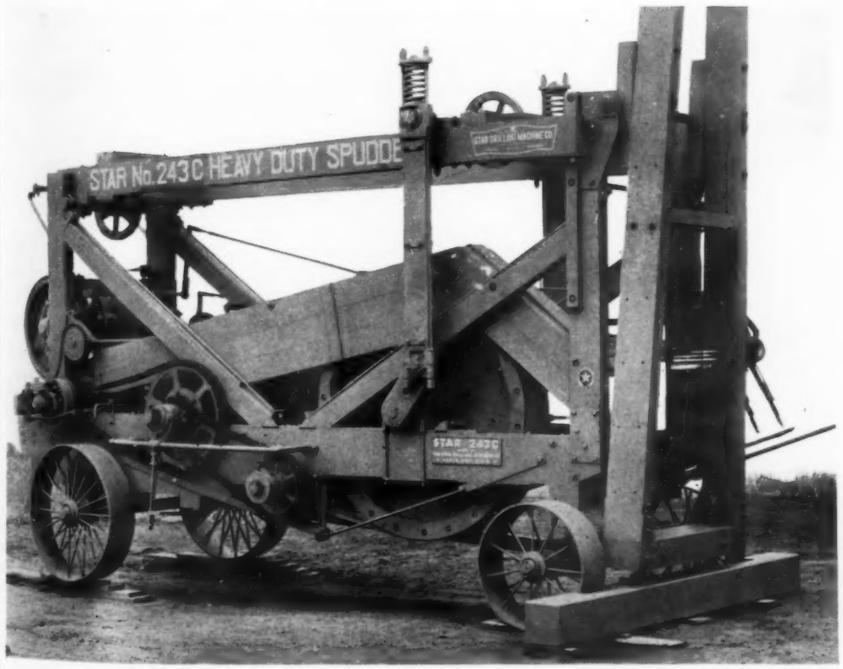
FIGURE 5 BACK OF DIAPHRAGM SHOWING METHOD OF SEALING HOSE CONNECTIONS

If moving, a blurred or blank record will be the result and erroneous data can be detected, saving much lost time caused by misleading readings.

The drift angle off vertical only, is available with the new Type-M Drift Indicator. Directional drift angle surveys are available with Single Shot and Multiple Shot Instruments.

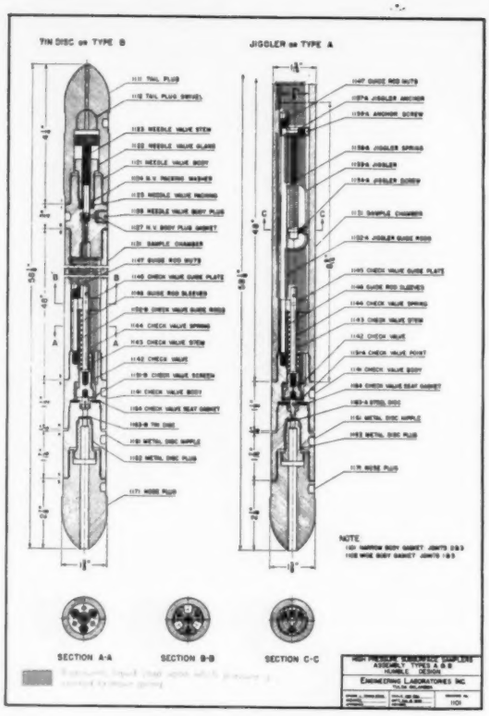
Below is illustrated a new spudder developed by the Star Drilling Machine Company and on display at the Petroleum Exposition in Tulsa. Designed for depths to 3,500 ft. the spudder has a double crank drive with shock absorber built into pitmans. Stroke may be adjusted from 20 to 44 in. Spudder and heel shafts are 4½ in. diameter, while spudding sheaves are 24 in. in diameter. An important feature is the travelling spudder sheave. It is controlled by a friction clutch equipped with brake. Bull reel and calf reel are chain-driven the former having a 42 in. diameter brake wheel and the latter having 36 in. diameter brake wheel. The sand reel is chain-driven, controlled by friction clutch and mounted on Timken roller bearings. The band wheel is 78 in. diameter with 12 in. belt face. As may be seen from the illustration the mast is the A-type leg bottom section with single pole top section. It is 45 ft. in height and can safely handle a load up to 24,000 lb. Power units may be gas or gasoline and up to 85 horsepower equipped with planetary reverse clutch and electric starter with battery.

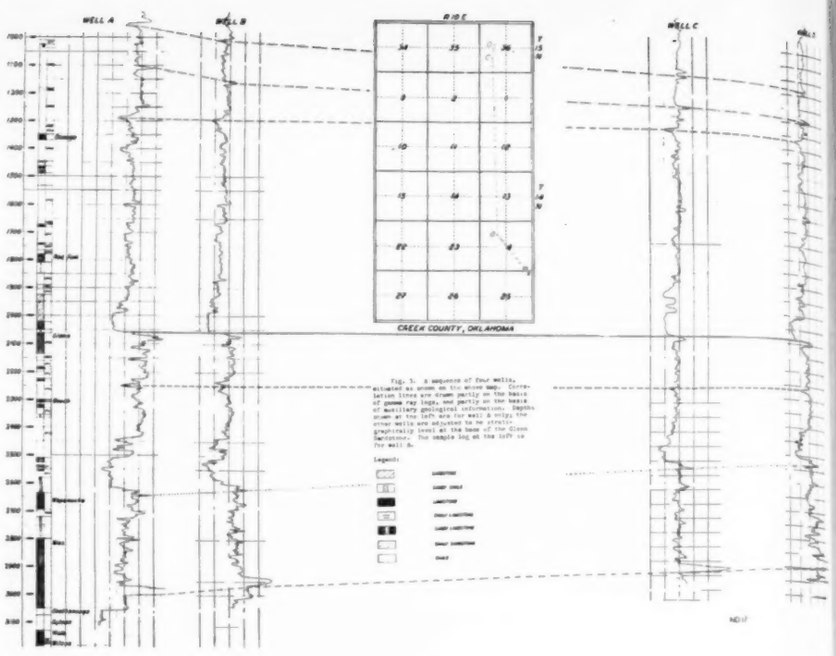




Another new spudder has been developed by Bucyrus-Erie Company and is being exhibited at the Tulsa show.

Like all Bucyrus-Erie rigs the new model known as 36-L it is of all-steel arc welded construction; the machinery is mounted inside the rigid trussed all-steel box frame. Standard equipment consists of a 48 ft. telescoping derrick with folding braces that need never be taken off the machine. The derrick carries casing tackle to handle up to 60,000 lbs. of static load. A special 54-ft. derrick is also available. Bucyrus-Erie's unique rubber shock absorber which may be seen in the inset at top of the above illustration is of course built in under the crown sheave but on the 36-L means are provided for blocking it out in deep drilling. The opinion has been expressed that the rubber shock absorber is of benefit on shallow



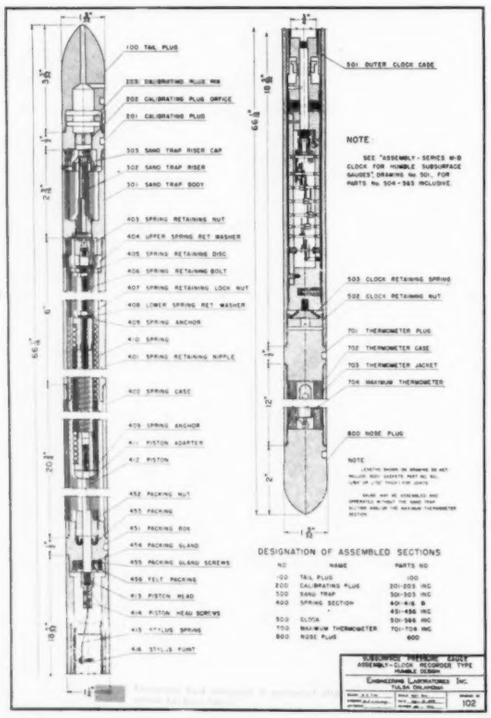


holes, but on deep drilling advantage is lost because of the stretch and whip action in the longer wire cable. The spudder is available on skids, rubber-tired trailer, or steel wheels. On rubber the rig weighs about 23,000 lbs.

The rig carries the usual three reels of a big spudder, the bull reel (without dividers) carrying to 9400 ft. of ¾ in. line, the sand reel 7800 ft. of ½ in., the calf reel to 530 ft. of ⅞ in. There are two speeds forward plus reverse on all drums and all are free wheeling and operated by friction clutch controls. Both bull reel and sand reel carry dual oversize brakes with equalizers. One brake is placed at each end of the drum to give balanced stresses and improved cooling under severe braking conditions. Bull reel and calf reel are gear driven, sand reel is chain driven.

The new rigs in Illinois are powered with gasoline engines developing 86 h.p. at 1400 RPM or 112 h.p. at 2200 RPM, and are equipped with water cooled manifold. A natural gas engine using gas or gasoline, as well as a Diesel, is also available.

The rig has power capacity to hoist 4,500 lbs. of tools from 2,500 ft. depth in high gear.



The subsurface sampler illustrated above is an instrument designed to secure samples within the well bore at predetermined depths and to retain them under pressure. It was developed by Engineering Laboratories, Inc., and is being exhibited at Tulsa. It consists essentially of a tubular chamber suitably sealed with a mechanism for opening and closing at the sampling depth. It resembles the subsurface pressure gauge in size and shape. The capacity is from 450 to 475 cubic centimeters. The sampler is lowered into the well on the same smooth wire line and with the same reeling equipment that is used with the subsurface pressure gauge.

The instrument is lowered to the sampling depth with the chamber evacuated, the top closed with the needle valve, and the bottom sealed with a metal disc covering the small fluid entry port. The metal disc is ruptured allowing the well fluid to enter the evacuated chamber until the pressure in the chamber approximates that in the well. As the instrument is withdrawn, the check valve seals the fluid entry port retaining the sample within the chamber. Successful operation naturally hinges upon effective rupture of the metal disc and closure of the check valve.

Two types are available. In type A (jiggler), the disc is of steel and is ruptured by puncturing with the needle point driven through the disc by the impact from the steel weight suspended within the sample chamber. The impact is caused by sudden jerk on the wire line. In type B (tin disc), the disc is of tin, yields and breaks after 10 to 12 minutes at the temperature and pressure of the sampling depth.

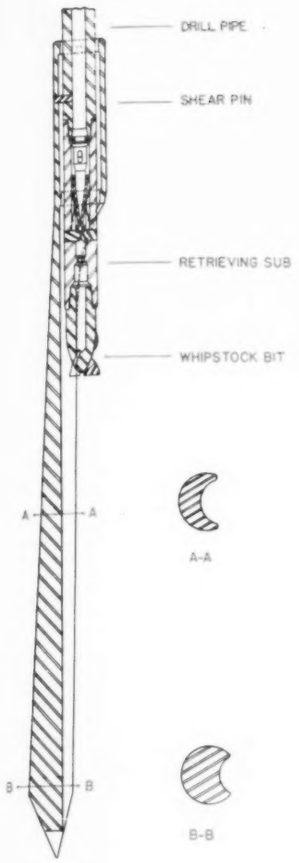
The accompanying print on the left shows the Humble type subsurface pressure gauge.

Well fluid pressure is admitted through ports near the top of the gauge, and acts upon a piston operating through a packing box against the tension of a helical spring. The extension of this spring is a measure of the pressure on the piston. The upper end of the spring is held by an adjustable anchor. The free end of the spring is attached to the upper end of the piston. The lower end of the piston carries a stylus and extends through a packing gland into a section of the gauge containing the recorder mechanism, which is kept at atmospheric pressure. The recorder drum in the case of the clock recording type gauge and the maximum recorder drum of the maximum recording type carry a sensitized paper chart upon which the stylus records the piston extension.

1. With ordinary care, pressures can be measured with an accuracy of 0.5 percent.

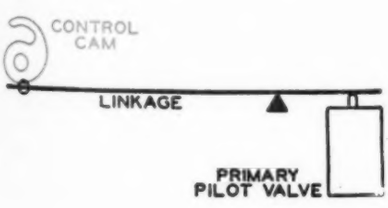
2. Pressures can be measured with the same relative accuracy for almost any desired range up to 6,000 lbs. per sq. in. or higher if necessary.

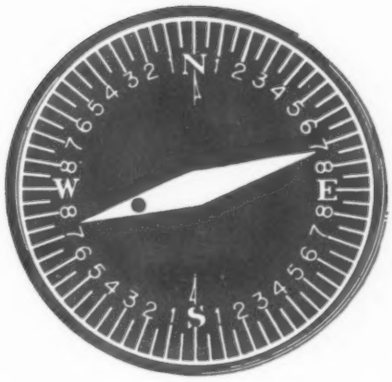
A new process of well logging has recently been introduced by Well Surveys, Incorporated (an affiliate of Seismograph Service Corporation and Engineering Laboratories, Incorporated of Tulsa, Oklahoma.) The process which is illustrated above consists in detecting gamma radiations emitted by radioactive materials present in the formations traversed by a drill hole and the continuous recording of the intensity of the radiations vs. depth of the drill hole and utilizing the records for correlation and rock identification. The outstanding feature of this process consists in the ability to log a well through casing (because of the ability of gamma rays to penetrate through iron.) This allows the



identification in cased holes in old producing field where no adequate log was kept of the formations above and provides an additional and very important correlatable parameter which is usually not associated with resistivity and porosity logs.

Principal exhibits of the Sperry-Sun Well Surveying Company are illustrated at the top of this page. On the extreme right may be seen a diagram of the Non-Magnetic Sub used for orienting accurately deflecting tools at the bottom of the hole; can also be used to obtain directional single shot records inside drill pipe. The sub contains two small magnets and provisions for seating an H-K Magnetic Single Shot instrument having a second compass in place of the inclination unit directly opposite the magnets in the sub. The relative azimuthal angle between the magnets and the direction of the face of the deflecting tools being known a photographic record taken with the single shot instrument indicates the





magnetic north and also the actual position of the deflecting tool.

When using the non-magnetic sub for making directional records inside the drill pipe the second compass in the single shot instrument is replaced by the inclination unit.

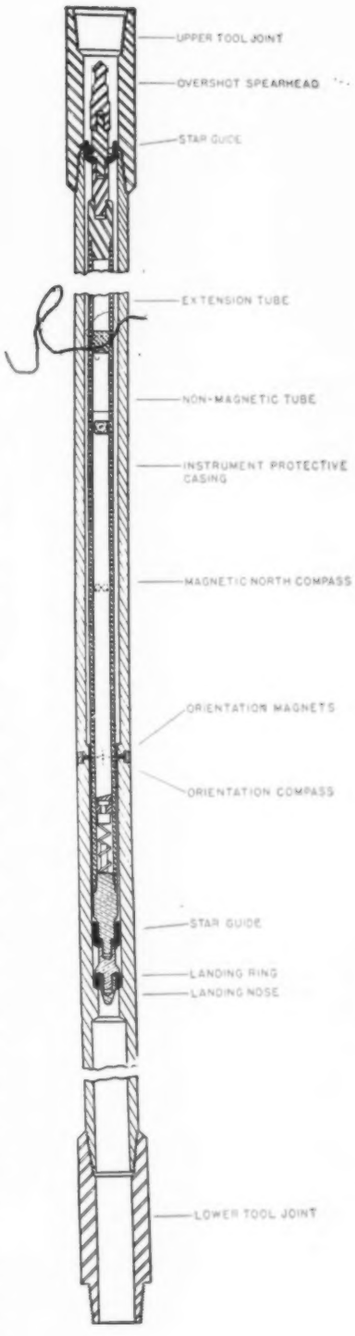
In the center above is illustrated a sample record showing the magnetic north as well as the direction of the deflecting tool. The section of the needle with the round circle indicates the direction of the tool.

The diagram on the left at top of page illustrates a new whipstock and retrieving sub. The outstanding features of the Keever Whipstock are a tapering outer surface and a straight inner surface comprising a channel laterally curved to form side walls which extend throughout the total length of the inner surface. This design which is somewhat revolutionary to the whipstock design previously used, has proven a great success inasmuch as it confines the bit in the channel throughout the whole length of its travel against the inner surface thereby preventing the rolling off of the bit, which so frequently occurs with the standard type whipstock. Moreover it makes the raising of the bit and the removal of the whipstock easy without binding or forming a wedge. The whipstock is removed from the hole by the Kothny Retrieving Sub which is arranged next to the bit, being provided with means expansible outwardly to engage the collar of the whipstock, by dropping a "Go-Devil".

The Micromax Pneumatic Control being exhibited at Tulsa employs two balances—an electrical balance for measurement; a pneumatic balance for control. The control it provides comprises: action which is a direct function of temperature change; action which is a function of both how far and how long temperature is off the control point.

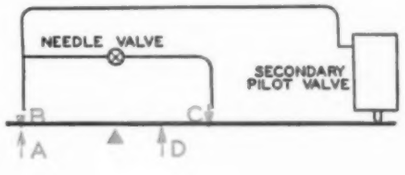
When temperature changes, causing unbalance in the measuring circuit, this unbalance is detected by a galvanometer and the mechanism restores balance in the measuring circuit by moving a slidewire—rapidly and accurately, whether unbalance is large or small.

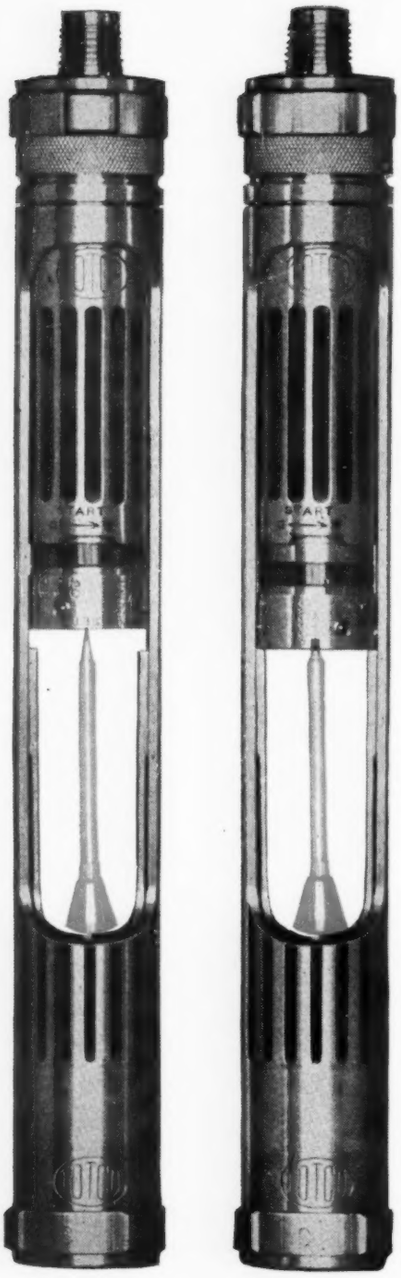
Turning as a unit with the measuring slidewire, a cam illustrated in red on the figure at left acts through levers to move the stem of a primary pilot valve, causing it to produce a

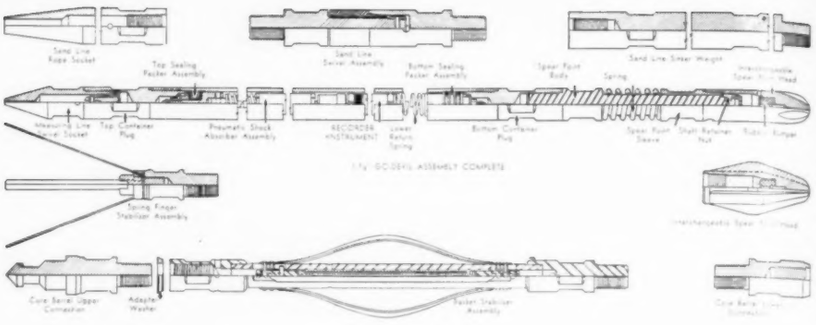


new pressure. For every temperature within the throttling range, the primary pilot valve has a definite stem position. Its outlet pressure, therefore, corresponds to actual temperature.

The outlet of this pilot valve is sometimes







connected directly to the diaphragm of the final control valve, to provide control which is simply a function of temperature change.

Though often adequate where lags are favorable and demand is fairly steady, such control has a drooping characteristic. For many processes, therefore, the control system includes a pneumatic balance shown in the right hand figure at the bottom of page 47, which relays the primary control action and provides automatic droop-correction (reset). This balance determines the pressure produced by a secondary pilot valve. On the lower side, it is acted upon by forces at bellows "A" and "D." "A" is loaded by primary-pilot-valve outlet pressure which, when temperature is at the control point, is one-half supply pressure. "D" has one-half the lever-arm of "A" and is loaded by supply pressure, making the balance independent of variations in air supply. On the upper side, the balance is acted upon by forces, having equal lever arms, at "B" and "C". When the balance is in equilibrium, each is under secondary-pilot-valve pressure. The latter may be anything from zero to full supply pressure, permitting the control system to be in balance at any position of the pneumatic-balance arm—thus providing for the final control valve to assume any position, with temperature at the control point.

Any change in primary-pilot-valve pressure acts at "A" to move the pneumatic-balance arm, causing a like change in secondary-pilot-valve pressure. This new pressure is transmitted to the diaphragm of the final control valve, thus relaying the primary control action, causing the valve to assume a new position.

The change in secondary-pilot-valve pressure is transmitted also to "B," offsetting the pressure change at "A" and bringing the pneumatic balance to equilibrium, which, however, is only instantaneous. Pressures at "B" and "C" start at once to equalize through a needle valve. At "C," this produces a pressure change (the amount of which depends on the differential between "B" and "C") such as to move arm and valve stem still farther in the same direction. Thus, a further change in secondary-pilot-valve pressure is transmitted both to the final control valve and to "B." Quickly and smoothly, this supplementary action brings the pneumatic balance to final equilibrium at a new position of its arm—with pressures at "B" and "C", equal; with pressure at "A" again one-half that at "D"; with the final control valve at a new position corresponding to the new demand—so that temperature is again at the control point.

Controlled vertical drilling depends upon correcting immediately any slight tendency of the hole to deviate while the angle is very small. At small angles, the natural plumb bob tendency of the drill string, when in tension and rotated with light drilling weight, will quickly straighten the hole in any formation. Then, when the angle is broken, the full amount of weight for most efficient cutting can again be safely applied. This process is repeated continually, with the result that the well is confined to a course that is for all practical purposes vertical. Angles are never allowed to increase to the point where the well establishes a definite directional trend at increasing angles; mechanical means of controlling the course of the hole are therefore unnecessary.

The entire Totco Recording Instrument developed by Technical Oil Tool Corp. is composed of just two simple-appearing, enclosed assemblies, the recording element and the angle-indicating element illustrated at left above. The timing mechanism, contained in the recording element, is so precisely made that the time for recording can be controlled in seconds. The angle indicator will come to complete rest in less than ten seconds, no matter how violently agitated. These features permit records to be taken with a stop of no more than 30 seconds when instrument and surface time have been properly correlated. The timing and angle-indicating elements cannot and need not be disassembled in the field for any reason, and require no cleaning, adjusting or oiling. As may be seen from the illustration (top, left) the inclination is indicated by a small perforation made by the recording needle in an accurately graduated replaceable composition disc. On the extreme left the needle is free before recording. The second illustration shows the timing element and angle indicator locked together in the recorded position.

The vital importance of the go-devil equipment used for running the recording instrument into the drill pipe must be equally stressed. The go-devil is, in fact, an integral part of the Totco Recorder, protecting the recording instrument completely from shock, pressure and dirt.

Less than one minute is required to prepare the recording instrument, insert it in the go-devil, and start it down the drill pipe. At the completion of the run, the recording instrument is removed from the go-devil and the record chart is read in one minute or less after the Totco Recorder reaches the surface.

Two sizes of go-devil equipment, together with their accessories as illustrated diagrammatically above, permit the recording instrument to be run in every practical manner. The same recording instrument is used in go-devils of both sizes.

The Otis Removable Bottom Hole Regulator, manufactured by Otis Pressure Control, Inc., is on display at the International Petroleum Exposition in Tulsa.

It is designed to add surface-controlled rate

of production to the advantages of bottom hole choking; it reduces highest tubing flowing pressures to safe workable limits; it eliminates freezing of surface controls, and incorporates a new-type valve which enables pumping down through the regulator if it becomes necessary to kill the well while it is in the tubing.

The Otis removable bottom hole regulator is, in effect, a pressure operated variable bottom hole choke. The effective size of the bean varies with the pressure drop across the assembly, and the pressure drop is controlled by the use of a surface choke or regulator.

As indicated in the illustration at the top left hand side of this page a movable valve seat (5) is urged against a valve (6) by a heavy coiled expanding spring (4). Wall pressure acting against the area of the movable valve seat, less the area of the valve, tends to raise the valve seat to permit flow up through the orifice in the valve seat. As a result, the flowing pressure above the valve seat is always less than the pressure beneath it by the amount of effective compression per square inch introduced into the spring as a result of the thickness of the adjusting ring (3) used. For example: If the desired reduction in surface pressure is 1,000 lbs. per square inch, an adjusting ring is used that will introduce sufficient compression into the spring to offset 1,000 lbs. per square inch well pressure as applied to the area of the valve seat less the area of the valve. If the desired pressure reduction is 1,500 lbs., a thicker adjusting ring is used, etc.

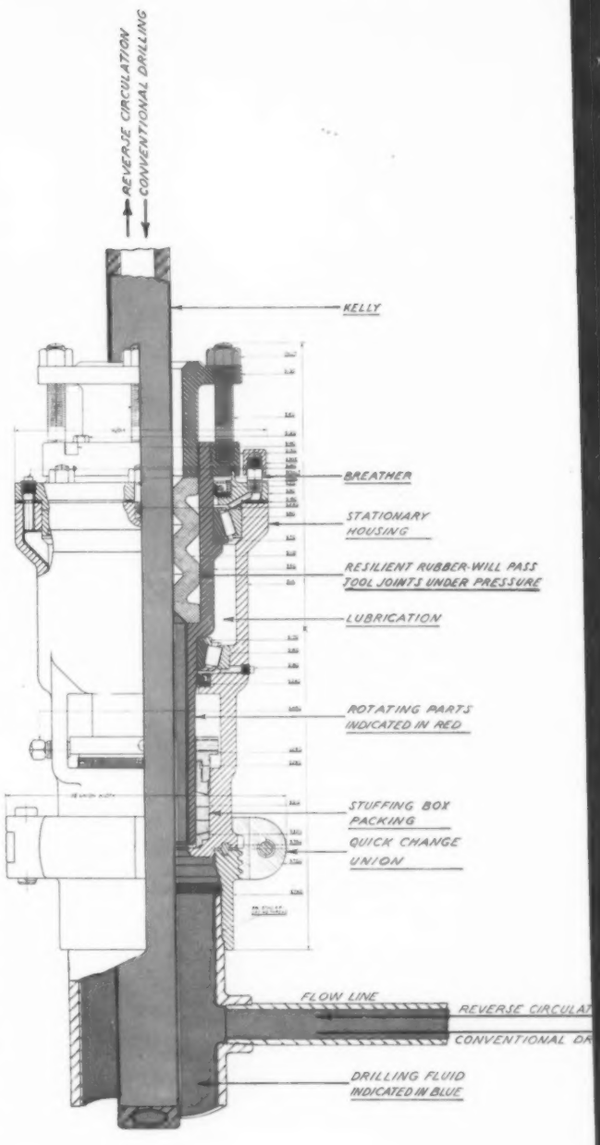
When the desired pressure drop is more than 1,500 lbs. per square inch, two or more Otis Regulators in the same string of tubing may be used, the desired pressure drop being proportioned between them as desired.

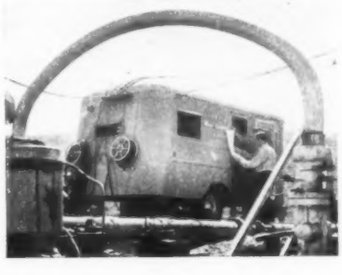
The amount of possible variation in rate of production is that amount which the well, after having its flowing pressure thus reduced, is capable of feeding against line or separator pressure. Under average conditions, the possible range in rate of production, after flowing pressures have been reduced to a safe, non-freezing point, is in excess of 4,500,000 cu. ft. of gas daily.

A small, compact, rotating blow-out preventer and drilling head has been designed and is being exhibited at the Tulsa International Exposition by The Guiberson Corporation. This blow-out preventer has the rotating feature and will provide a positive pack-off between casing and kelly, drill pipe or tubing, and may be used for drilling in under pressure, running tubing under pressure or cleaning out well by reverse circulation. Available in three sizes, the type illustrated at the top right hand side of this page is tested to 3,000 lbs. and can pack off kelly, drill pipe, etc. to a maximum diameter of 4 1/8 in. Other types will pack-off diameters up to 8½ in. and have been tested to 6,000 lbs.

The drilling head housing and core is made of alloy steel pressure castings, while the bearings are extra large. The stuffing box parts are all bronze construction and the packing is of high pressure, oil resisting materials allowing the core to rotate freely.

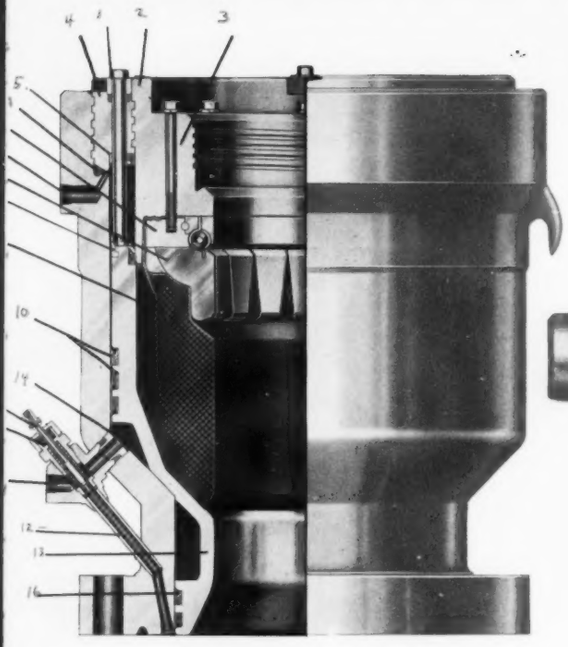
This tool is suitable for pressure of 1,500 lbs., has an overall height of 34 in., diameter of 14 1/8 in. The opening through head with rubber removed is 4¾ in. The upper tapered roller bearing has a capacity of 48,900 lbs. radial and 52,400 lbs. thrust at 100 r.p.m. The lower tapered roller bearing has a 40,750 lbs. radial capacity and 43,700 lbs. thrust capacity, both at 100 r.p.m. Square hexagonal or fluted kellys may be used and the tool will accommodate 2, 2½ or 3 in. tubing, 2 3/8, 2 7/8 or 3½ in. OD drill pipe and 2½, 3 or 3½ in. kellys. It weighs 530 lbs.

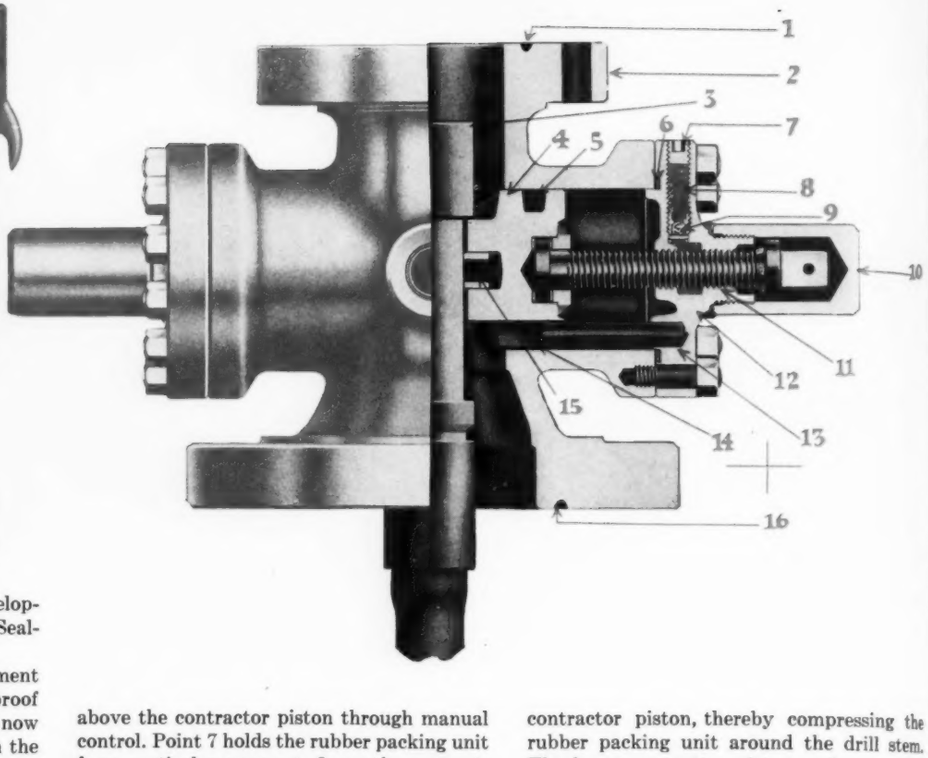




Baroid Well Logging Service will demonstrate at Tulsa the manner in which its system of continuous well logging is accomplished right at the time of drilling.

In drilling a well, the bit drills up and disintegrates a circular core of the formation being drilled. If gas, oil or salt water are contained in the pore spaces of this core when it is drilled, the content of the pore spaces must of necessity be picked up by the drilling fluid. If the drilling fluid is continuously analyzed upon its return to the surface and correlated with the depth from which the cuttings came, the gas, oil or salt content of the formation can be accurately determined. Illustrated at left is the trailer used for this service by Baroid.





A new drilling control instrument developed by Martin-Decker and known as "Sealtite" will be on exhibition at Tulsa.

One important feature of this instrument is that it has been made absolutely leakproof and pressure-tight. The instrument is now factory filled and sealed for all time with the correct amount of fluid. It requires no further attention, such as pumping up or adjusting, and is ready for immediate installation when it reaches the rig.

The weight indicator reads directly in thousands of pounds, kilograms, or points on a 16 in. dial face that is indirectly illuminated for clear visibility at night. There are ten interchangeable dials inside the gauge case for use with all conventional string-ups and line sizes.

The Sealtite is a complete control instrument, recording in permanent chart form, weight on bit, mud pump pressure and torque on drill pipe over a 24 hour period.

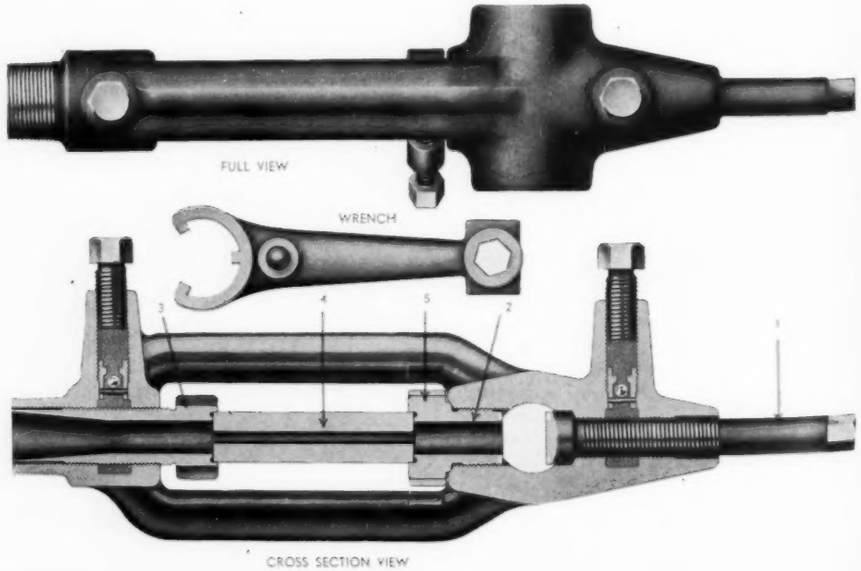
A new blowout preventer, known as Type R is being shown by the Hydril Company and is illustrated at the top left hand side of this page. It has a wide pack-off range from 13 3/8 in. down to 4 1/2 in. outside diameter. There is sufficient reserve pack-off material so that an unworn blowout preventer of this type can pack off around as small diameter as 3 1/2 in. drill pipe. Complete in itself, the tool acts as a shut off valve to retain well pressure by packing off around any member of the drill string, permits the string to rotate or to be moved up and down. In fact the whole string can be run to bottom or pulled out through the packing unit. It has been tested to 5,000 lbs. per sq. in. cold water pressure and all flanges are machined to Series 900 A. P. I. dimensions.

In the illustration above 1 is the compression indicator used to check the service life of the packing unit, 2 is the packing assembly head; when the head is unscrewed, the entire packing asembly is removable as a unit. Three is the drilling packer or flow line connection, 5 and 5A are head seals which prevent escape of fluid under pressure and 6 is the top connection for applying pressure above the contractor piston through manual control. Point 7 holds the rubber packing unit from vertical movement, 8 are the supports which form a protecting cone above the rubber packing unit as it is compressed inward to pack off around the drill stem. The rubber packing unit is indicated at 9 and the contractor piston seals which prevent bypassing of fluid when the contractor piston is actuated by fluid pressure may be seen at 10. The loading valve is shown at 11 and permits operation of a blowout preventer by pump pressure, allowing for well pressures higher than pump pressure to enter the control chamber and effect the closure. Twelve is the loading line and 13 the contractor piston vertically movable in the body. As it rises, the internal taper compresses the packing rubber inward to effect a secure seal around any drill string member within the bore of the packing rubber. Control chamber is at 14 and the pump connection at 15. The latter permits the attachment of a pump for applying pressure under manual control to raise the contractor piston, thereby compressing the rubber packing unit around the drill stem. The lower contractor piston seals are at 16 and the loading valve stem packing is at 17.

The Cameron "LD" ram-type tubing control head serves a four-fold purpose: (1) It provides safe, dependable control during every step of completion operations; (2) provides three methods of suspending and sealing the tubing string; (3) obviates the need of a cement retainer when making a squeeze job; and (4) is practical on any reworking subsequent to the original completion of the well. When used in conjunction with a second Cameron ram-type control unit, tubing may be raised or lowered, or pulled from the well under pressure without killing. Provision is made for three types of tubing suspension, the most widely used of which is the method illustrated above. Employing a special male by female hanger nipple, the tubing is suspended and sealed on the closed rams.

From the moment the tubing string is

CAMERON TYPE "A" FLOW WING



started in the hole, the rams provide dependable blowout protection. In most instances no additional control equipment is required during drilling in operations. The rams are equipped with self-feeding ram packing elements, which assure a positive, pressure-tight seal and permit sustained pipe movement under pressure. Conventional gland type stuffing boxes around the ram thrust screws have been replaced by repackable plastic packing seals, as illustrated. Briefly, a recess is provided in the bonnets around the ram thrust screws, and this recess is filled with plastic packing through a check valve. Obviously, this seal may be safely repacked under pressure at any time by simply injecting more plastic packing.

In order that the rams of this unit may be operated with ease against the highest well pressures, they are provided with a by-pass port on the lower side. This port also serves as a guide for the ram by mating with a guide pin attached to the bonnet. As an additional safety feature, the ram screws are enclosed by a high pressure bull plug on 6000 and 10,000 lb. test models.

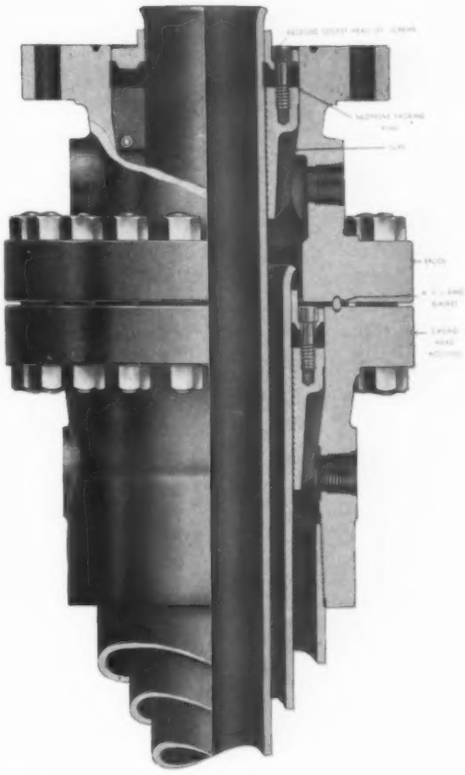
In the illustration on the opposite page, 1 is the standard A. P. I. ring groove, 2 the standard A. P. I. flange, 3 special hanger nipple for suspending and sealing tubing on closed rams, 4 ram and 5, ram rear seal. Six, the hydraulic packing rings, 7 plastic packing feed plug, 8 plastic packing, 9 ball check valve, 10 ram screw cap, 11 ram screw, 12 bolted bonnet, 13 ram guide pin, 14 pressure by-pass, 15 patented self-feeding ram packing element, 16 standard ring groove.

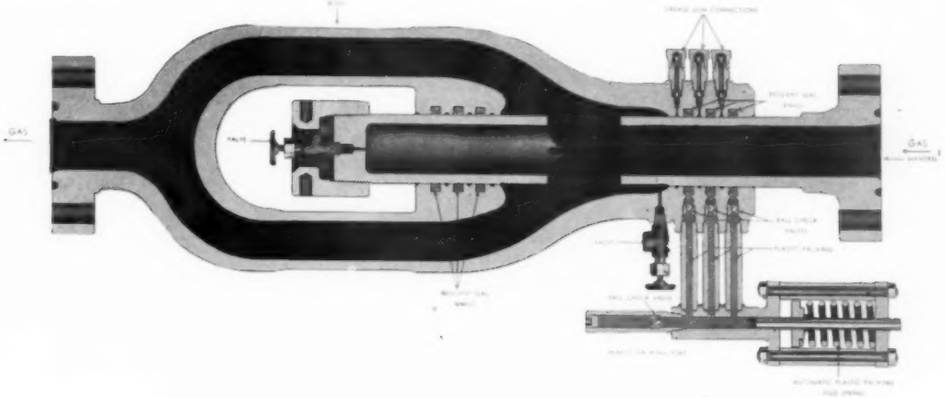
The Cameron Type "A" Flow Wing illustrated on the bottom of the opposite page combines in a single unit the double function of a valve and quick-change positive flow bean. The valve section of this unit permits a quick, positive, and easily operatable shut-off while changing the positive flow bean without the necessity of closing the wing valves or master valve. The flow bean section of this device is designed to permit the changing of the flow bean without breaking out any threads or removing a flange.

Referring to the cross-section view on the facing page, when it is desired to change a flow bean, the hexagonal socket in the wrench is fitted to the valve stem (1) and the valve closed against the seat (2). The spanner part of the wrench is then applied to the clamp screw (3) which must be turned only two turns to release the flow bean (4). After installing a new flow bean of the desired orifice size, it is clamped in place by the clamp screw. The valve is then opened and the well is back on production.

The flow beans of this unit are exactly six inches long and choke sizes are available from $\frac{1}{16}$ in. to $\frac{3}{4}$ in. in increments of $\frac{1}{64}$ in. Either cross or tee types are available with screwed, flanged, or flanged by screwed connections, two inch size only. Test pressures are 6,000 lb. or 10,000 lb.

The sectional drawing at the top right hand side of this page illustrates the design and construction of the new Type W casing head and spool developed by Cameron Iron Works and shown at the International Petroleum Exposition. This tool is provided with a Neoprene seal of the space between casing strings rather than a welded seal. As shown in the illustration, after the casing has been cemented and suspended on the slips, a split Neoprene ring and three-segment packing gland are assembled on top of the slips. Recessed socket head set screws, which screw into the top of the slips, are utilized to compress the Neoprene packing and thus effect a pressure-tight seal between the casing strings.





The Cameron Balanced Expansion Joint illustrated diagramatically in the center of this page is of the slip joint type. It is being shown at Tulsa and was designed to overcome the disadvantages of conventional expansion loops. It is generally conceded that a loop provided in a line to take care of expansion and contraction due to temperature changes, also responds to pressure changes, or surges, in the same manner as a Bourdon tube. That is, as pressure increases the loop has a tendency to straighten out, imposing severe strain on the connection and intensifying the vibrations induced by the compressors. The Cameron Expansion Joint is designed to eliminate the disadvantages of expansion loops.

As clearly illustrated in the accompanying photographs, the joint consists of a mandrel which slides in a body provided with stuffing boxes. As the mandrel is of uniform diameter, the stuffing boxes seal identical pressure areas and, therefore, there is no end thrust. The gas enters the joint through the mandrel and passes into the body of the joint through ports located between the stuffing boxes. It then passes from the body through the Y connection into the line following the red area in the diagram. In order that the stuffing boxes may be repacked under pressure without shutting down the plant, conventional gland type stuffing boxes are eliminated. Pack-off is effected by forcing plastic packing around plastic packing retaining rings which are in contact with the mandrel. In order that these joints may be unattended for a considerable length of time, a spring loaded packing feeding device is provided on each plastic packing stuffing box. Thus, a reservoir of plastic packing is always available.

The head body is forged steel, all parts testing to 4,500 lbs. cold hydrostatic pressure.

For high pressure deep well use, McEvoy has developed a tubing head illustrated diagramatically at left above, for use where it is desired to lower tubing below point of final suspension to set packers or any similar operation under full pressure control. This head may be used with 5½ in. or 7 in. casing, 2 in. or 2½ in. tubing. Lower connections are threaded or have 8 in. or 10 in. flanges and weight from 373 lbs. to as high as 812 lbs. with a pressure range from 4,000 lbs. for the threaded 373 lb. model to 10,000 lbs. for the flanged 812 lbs. model. A jay slot provides connection from tubing to casing permitting the tubing to be lowered below final point of suspension. The tubing hanger may be landed through blowout preventers and master valve and then locked in place.

The McEvoy casing head illustrated at right above, represents a simple and rugged type of well completion equipment. This equipment was designed and tested to withstand loads equivalent to 10,000 ft. to 15,000 ft. of casing without bottle necking the casing at the point of suspension.

The illustration shows a two-string casing system assembled from a casing body with API Series 900 top flange, a slip type hanger, and a welding flange with stuffing box and test pressure connection.

At their International Exposition booth this year, Larkin Packer Company is featuring both ball valve float shoes and tubing heads. Both of these pieces of equipment are illustrated at the bottom of this page.

The ball-type float shoe on the right features a shock resistant, fabricbase bakelite guide. This bakelite guide has a tensile strength of 7,200 lbs. and a compressive strength of 36,000 lbs. The ball valve, also bakelite, is precision machined and lapped to assure accurate seating. There is a 7 sq. in. area valve opening, for faster, easier cementing. The float shoe has been tested, without failure of any kind, under 62,000 lbs. of hydraulic pressure. It is made for 4½ in. to 24½ in. D. D. casing.

The interchangeable tubing head is completely interchangeable and all parts of the 5½ in. O. D. head will fit into the 7½ in. O. D. model. The inside diameter is the same as that of the pipe in which head is run, so that any packer or tools that will run in the pipe will go through the head. The head is only 18 in. high. The stripper rubber is Neoprene, proven highly resistant to wear and oil.

Meeting the demands of multiple-zone production when oil from different sands must be kept segregated, the Baker retainer production packer has been designed to pack off between two production horizons and produce them separately. Production from the lower zone is through tubing which is run through the packer; production from the upper zone is through the annular area between the tubing and the liner or casing. When production from three zones is to be kept separate, an additional packer is used. The packer is furnished in three designs—the packing head seal type, the continuous double seal type and the continuous single seal type—so as to meet any specific condition encountered. All types are of the same basic construction but with individual features providing for raising and lowering the tubing to regulate flow and gas/oil ratios, to clean out sand, to wash over, to swab in the different zones or to shut off the bottom producing horizon when desired.

The construction of the retainer production packer, packing head seal type, is shown in Fig. 1, illustrated at the top of the opposite page. It is run into the hole on the setting tool shown in Fig. 2. At the top of the packer is a plain setting head equipped with left-hand square threads into which corresponding left-hand square threads in the head of the setting tool are screwed. The setting tool is attached to the bottom of a running-in string, usually consisting of tubing, which is made up with an expansion joint a few feet above the setting tool. The packer is run to its predetermined position in the well and is tripped and set to seal off against the liner or casing with an oil-resisting packing rubber between two lead seals. It is prevented from moving either up or down the pipe by two sets of slips.

In setting the packer, a tripping ball is dropped into the running-in string and falls to its seat in the setting tool. Hydraulic pressure generated by pumps at the surface is then applied to the packing member through

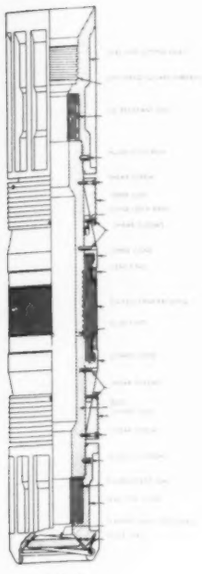


FIG. 3

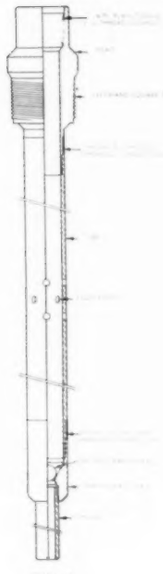


FIG. 4

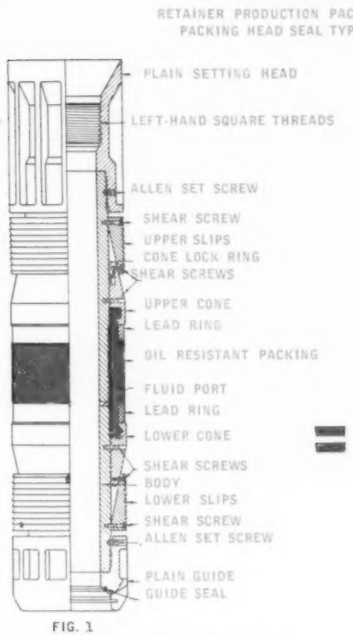


FIG. 1

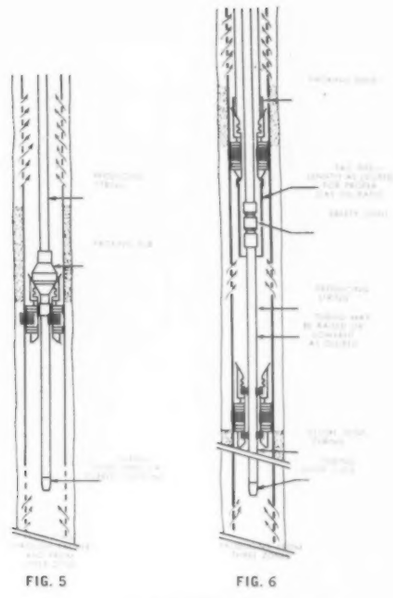


FIG. 5 FIG. 6

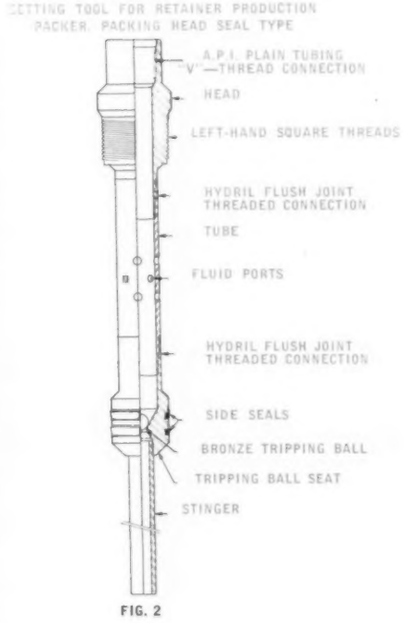
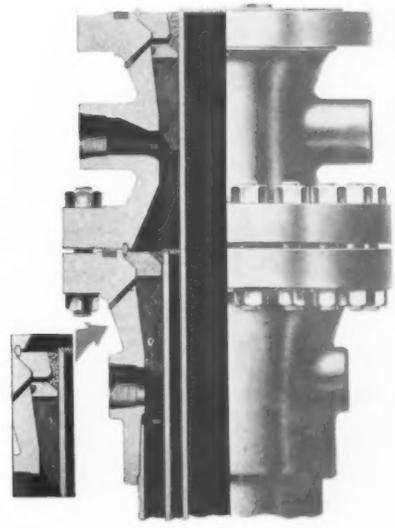


FIG. 2



fluid ports in the setting tool and thence through the fluid ports in the body of the packer. This pressure elongates the packing and causes it to move upward until it shears the screws holding the upper set of slips. Passage of fluid down around the setting tool is prevented by the side seals located below the fluid ports. The running-in string is then picked up to set the upper slips which prevent upward movement of the packer in the liner or casing. The strain thus imposed causes the body of the packer to slide upward until stopped by the packing unit being completely expanded against the liner or casing. This movement also shears the screws holding the lower slips and forces them against the pipe to prevent downward movement of the packer.

With the packer thus anchored in the liner or casing, the running-in string is lowered until all strain is removed and the expansion joint partially telescoped. The string is rotated to the right to unscrew the setting tool which is then pulled out of the hole.

The two-zone production method using the retainer production packer, packing head seal type is illustrated in Fig. 5.

The retainer production packer, continuous double seal type is shown in Fig. 3. This type has a sleeve-type seal at each end which maintains a continuous, fluid-tight seal against a string of flush-joint tubing passing through it and into the production horizon below. It is set in the same manner as described above but uses the setting tool shown in Fig. 4 for the setting operation.

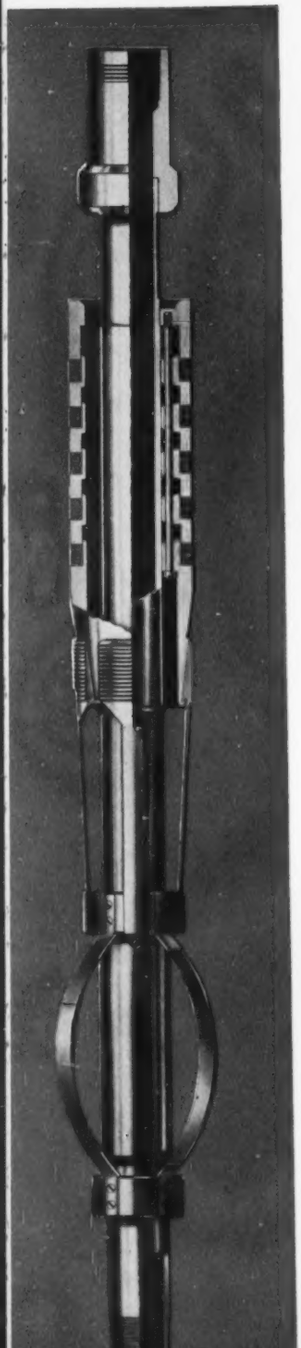
The safety joint shown in Fig. 5 serves as a safety means for use in the event the tubing becomes sanded up. It is equipped with left-hand square threads and permits the string above to be unscrewed and the remaining section washed over.

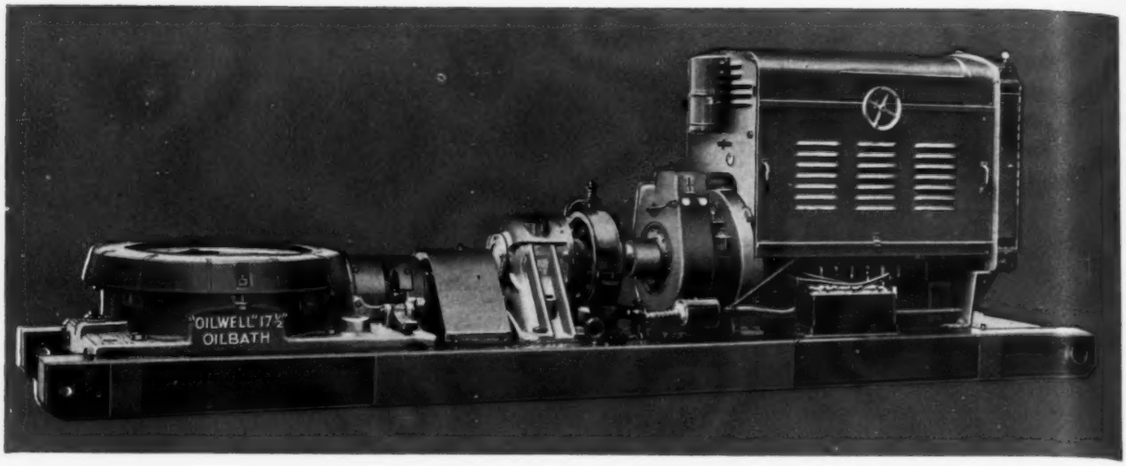
The three-zone production method using two retainer production packers is illustrated by Fig. 6. Any of the three types may be employed for the lower packer but the packing head seal type is used between the middle and top zones. A tail pipe of proper length is attached to the bottom of the upper packer and a packing shoe designed to seat in the setting head is made up on the bottom of a flow string which is run to separate the production from the middle and top zones. With the well thus completed, oil from the bottom zone flows up through the tubing; oil from the middle zone flows up outside the tubing but through the tail pipe, the upper packer and the flow string; and oil from the top zone flows up the annular space between the flow string and the liner or casing.

Rector Well Equipment Co. are exhibiting a mandrel suspension casing and tubing head and a slip suspension type casing head.

The slip suspension type casing head illustrated directly above is extremely simple in design, and therefore easily installed. This simplicity of design is made possible in part by the use of a patented pressure sealing and casing hold down medium, this being a single API metal seal ring acting in conjunction with a steel hanger welded to casing after slips are set. The design of this hanger makes possible a long, secure and thoroughly dependable weld. This combination of slips, welding rings, and pressure seal ring provides a positive, support of casing, a positive seal of pressures, and a hold down medium that prohibits any upward movement of casing due to expansion of metals or extreme pressures.

Suspension of casing is accomplished with slips without a slip bowl, between casing head body and slips. The radial thrust due to weight of casing is thus distributed evenly over a large area. All sizes have full opening through bodies, and there are no beveled seats or other projections.

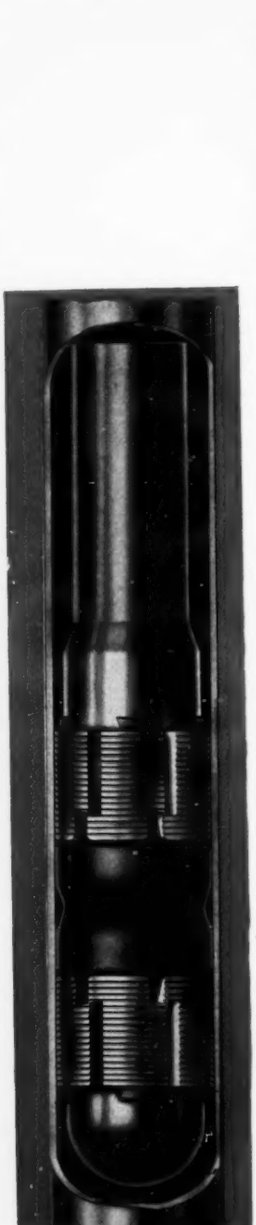




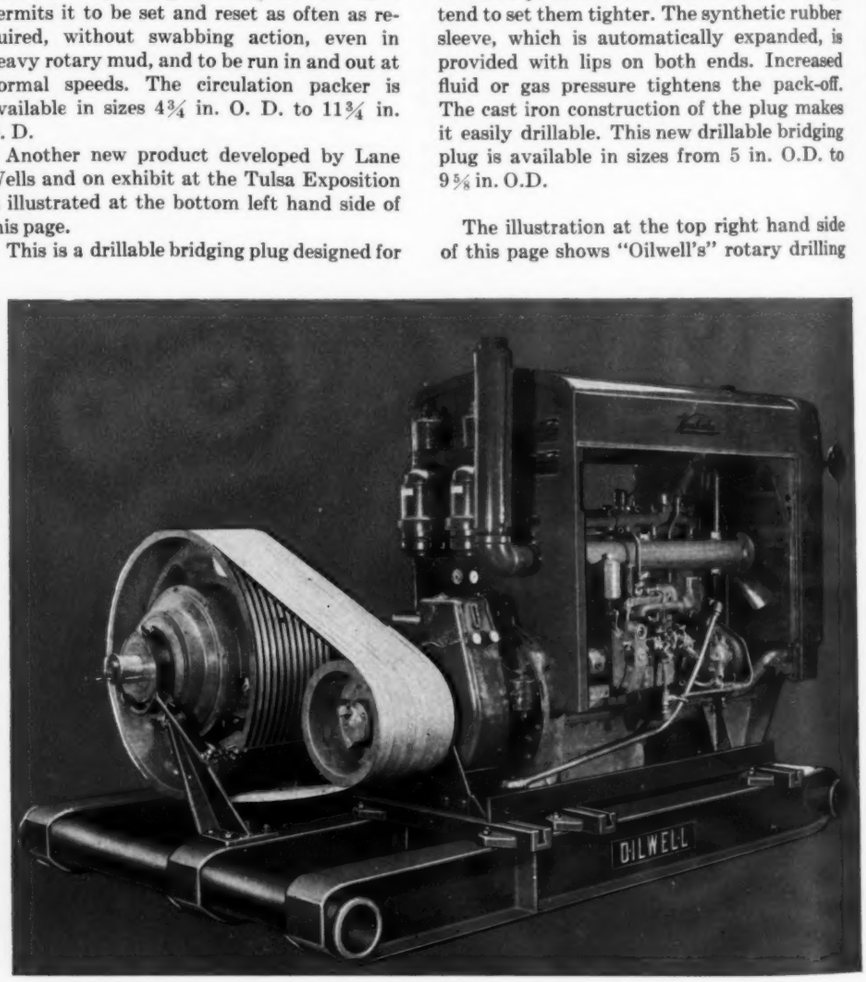
The Lane-Wells Quinta-Seal Circulation Type B Packer illustrated at the top left hand side of this page is provided with five flat side-wall rings of rubber or Neoprene giving ample bearing surface and assuring a positive seal and resistance to gas pressures. Heat-treated alloy steel slips give a positive grip without cutting. The body of strong, seamless steel casing or tubing has the same internal diameter as the string on which the packer is run. The large circulation area between the packing assembly and the tube permits it to be set and reset as often as required, without swabbing action, even in heavy rotary mud, and to be run in and out at normal speeds. The circulation packer is available in sizes 4¾ in. O. D. to 11¾ in. O. D.

Another new product developed by Lane Wells and on exhibit at the Tulsa Exposition is illustrated at the bottom left hand side of this page.

This is a drillable bridging plug designed for faster operation, accurate depth placement and absolute packoff. Run in place and set by a Lane-Wells Gun Perforator Service Unit, this new plug is lowered into the hole much faster than plugs of earier design because of greater clearance between the plug and the casing. Accurate weighing and measuring devices assure positive control and accurate depth placement. The plug is so designed as to assure its staying exactly where it is set. The slips are actuated by the setting tool and excessive pressures from above or below only tend to set them tighter. The synthetic rubber sleeve, which is automatically expanded, is provided with lips on both ends. Increased fluid or gas pressure tightens the pack-off. The cast iron construction of the plug makes it easily drillable. This new drillable bridging plug is available in sizes from 5 in. O.D. to 9⅝ in. O.D.



The illustration at the top right hand side of this page shows "Oilwell's" rotary drilling



unit with internal-combustion engine prime mover. Smooth and flexible power flow like that of the steam engine, together with a wide range of power and speed is accomplished through the use of an hydraulic torque converter between the multi-cylinder gas engine and table drive. The hydraulic drive cushions the shocks which are inherent in rapidly turning a long string of drill pipe in torsion, thus contributing not only to the life of the moving parts of the rotary, but to the drill pipe and bits as well.

Whether the drilling requirement calls for slow table speeds as in coring operations, or for high table speeds ranging between 250 and 300 r.p.m., the drive responds through simply changing the engine throttle setting. There are no other controls. If a bit or reamer should stick while the engine is operating with a normal, fixed throttle setting, the output torque requirement reaches a point greater than torque input, with the result that there is no further wind-up of the drill pipe. To unwind and free the bit or reamer, it is only necessary to close the engine throttle to the idling position.

Equipped with either a 150 h.p. or 200 h.p. multi-cylinder gas engine, it offers the usual features of independent rotary drive. It extends the capacity of a compound-engine rig, as it releases both engines for slush-pump drive without connection to the rotary.

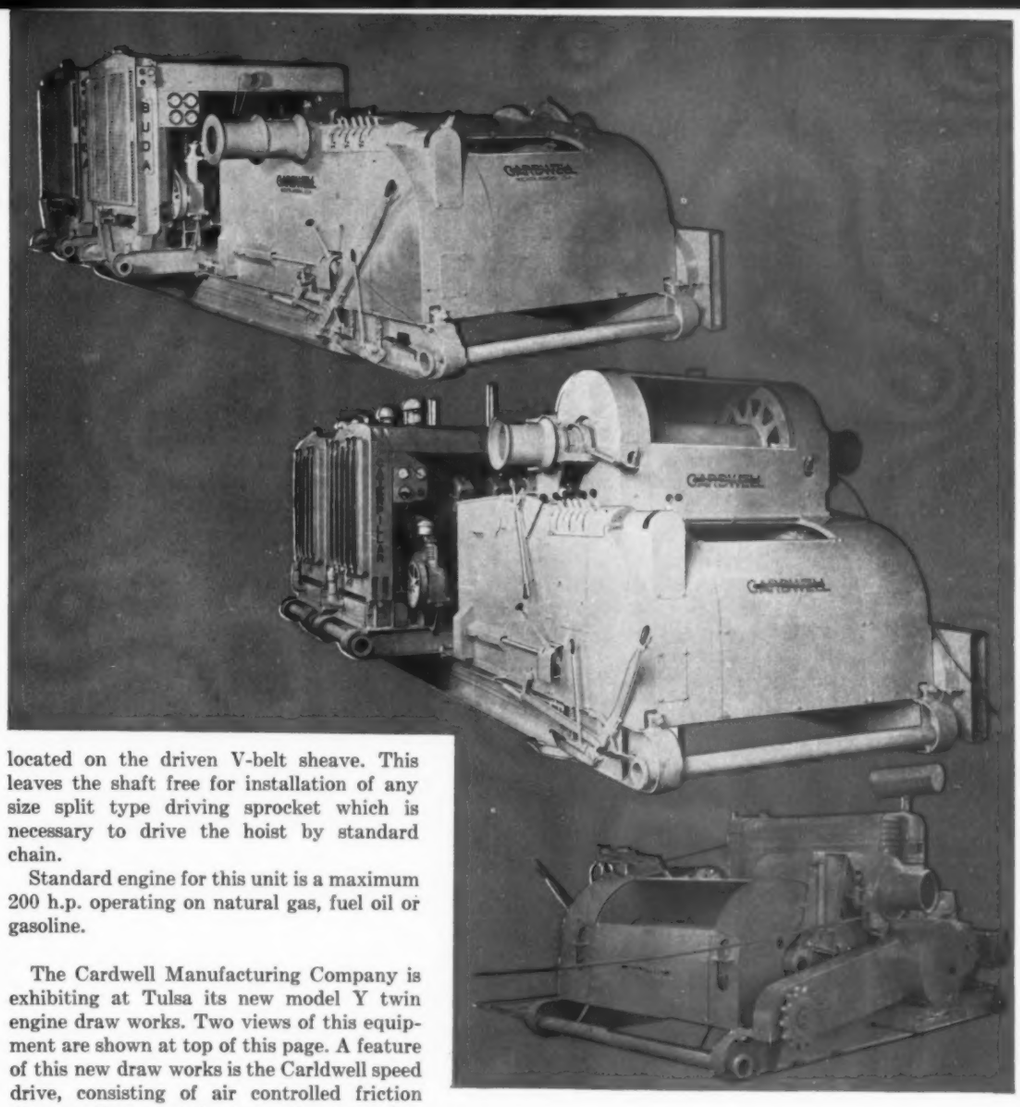
In foreign drilling operations, where fuel and water are difficult to obtain, many operators have felt the need of a powerful and flexible, yet lightweight, conversion unit to convert standard steam hoists to internal combustion engine drive. In rotary operations to 3000 or 4000 ft., and where the drilling program would not immediately justify the purchase of a complete new power hoist, the "Oilwell" conversion unit illustrated at the bottom, right hand side of the opposite page permits the use of any standard two-speed steam hoist with a conventional gas, gasoline or fuel oil multi-cylinder engine.

The controls of this new unit to the heavy reverse clutch are identical with steam engine controls in location and operation. Drillers and crew do not have to learn a new set of operating characteristics, since the "Oilwell" unit handles like a steam engine. Actually, the performance of the engine is unique, in that it is impossible to stall it when picking up a load or when making a hard pull. This is accomplished by means of a hydraulic transmission or torque converter, which, on demand, multiplies the engine torque five times.

The engine torque is transmitted through the hydraulic torque converter, which also functions like a variable-speed mechanical transmission, except that it makes available a multitude of ratios without necessity of gear shifting. There is no mechanical connection, such as a friction clutch, between the high-speed and low-speed shafts of the converter, all drive being hydraulic.

From the output or low-speed shaft of the converter, the drive is taken through V-belts to the reversing countershaft. The forward and reverse directions are obtained by a friction clutch and a planetary reverse located on the driven V-belt sheave. This leaves the shaft free for installation of any size split type driving sprocket which is necessary to drive the hoist by standard chain.

Standard engine for this unit is a maximum 200 h.p. operating on natural gas, fuel oil or gasoline.



The Cardwell Manufacturing Company is exhibiting at Tulsa its new model Y twin engine draw works. Two views of this equipment are shown at top of this page. A feature of this new draw works is the Carldwell speed drive, consisting of air controlled friction clutches. This special drive makes it possible to change from any one of twelve speeds without stopping the pump, rotary table or hoisting operations. Air controls also operate the automatic cathead, rotary table drive friction clutch and slush pump drive.

There are no engine power take-off clutches used in this draw works, as each engine drives individually to the Cardwell speed drive friction clutches. Both engines may be used to either or both the draw works and pump; or either engine may be used to the draw works or the pump. The same line pull is developed by either one or two engines but when two engines are employed, line speeds are doubled. If one engine fails, the other engine will pull the load of the drill pipe, but at one-half the speed of two engines.

The rotary table is driven from a friction clutch through a gear box to eliminate the unnecessary running of chains and sprockets. Rotary table speeds vary from approximately 20 to 200 r.p.m., even when either or both engines are employed at full speed on the pump.

Single adjustment, fully equalized, dual safety brakes will hold the full capacity load should one brake fail. Brakes are controlled by ratcheted hand lever, easily set for steady drilling feed.

The complete draw works and engines may be hauled on one truck, and may be used for rotary drilling to 8,000 ft. with 3 ½ in. drill pipe or to 6,000 ft. with 4½ in. drill pipe.

Directly beneath the two views of the Model Y draw works, is a single view of Cardwell's Model L draw works for workover or slim hole use.

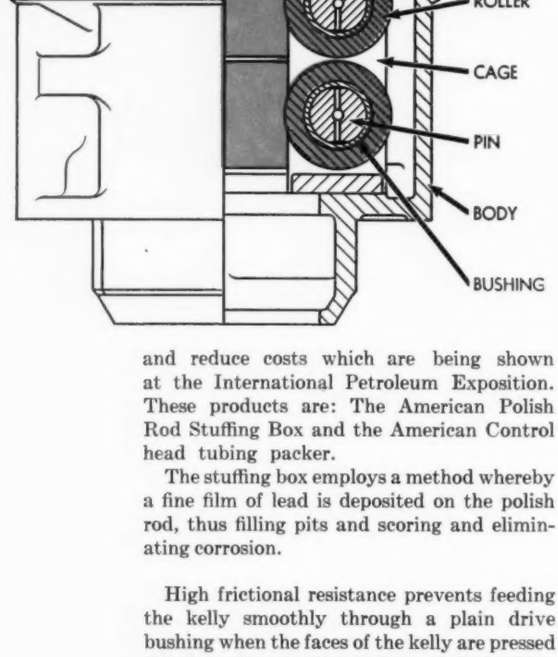
This new, light-weight draw works, driving from a hydraulic transmission through a Carldwell speed drive, operates just like a steam rig. The entire range of engine power is constantly available at maximum speed without shifting gears.

The hydraulic transmission sprocket drives to an auxiliary shaft on which three friction clutches are mounted. The drive, consisting of two of these clutches with sprockets driving to the countershaft,makes it possible to double the line speed. The third friction clutch operates the rotary table drive and is supplied with clutch brake for stopping the table.

Air controls operate the two friction clutches, rotary table drive friction clutch and the countershaft brake.

Model L draw works is for rotary drilling to 4,500 ft. with 3½ in. drill pipe or to 3,500 ft. with 4½ in. drill pipe and for work over jobs to 8,000 ft., using 2½ in. tubing.

The American Iron & Machine Works Company has introduced recently two new products designed to increase efficiency



and reduce costs which are being shown at the International Petroleum Exposition. These products are: The American Polish Rod Stuffing Box and the American Control head tubing packer.

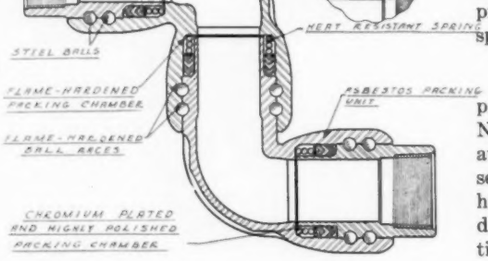
The stuffing box employs a method whereby a fine film of lead is deposited on the polish rod, thus filling pits and scoring and eliminating corrosion.

High frictional resistance prevents feeding the kelly smoothly through a plain drive bushing when the faces of the kelly are pressed tightly against the flat surfaces of the bushing by the torsion in the drill stem. To overcome this obstacle Baash-Ross has designed the roller kelly drive bushing illustrated at the top left hand side of this page.

Each of the driving surfaces of the kelly is contacted by two extra large diameter rollers, and by no other part of the drive bushing. These big rollers reduce frictional resistance to feeding to the minimum, and cannot tear or gall the kelly.

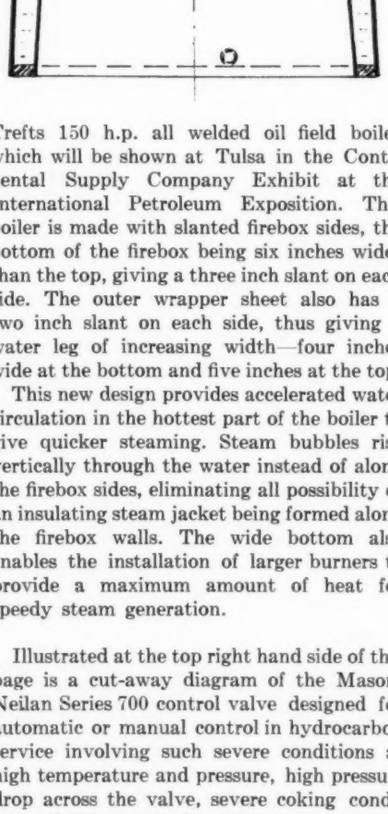
Known as Type 2R these bushings have high roller hardness which greatly reduces wear on the outer surface of the rollers.

Ball bearing, high temperature swing joints are being featured in the Chicksan Tool Company's exhibit at the Tulsa oil show. The illustration below emphasizes some of the principal features. All rotating members are constructed of steel, accurately machined to close tolerances. No brass or bronze sleeves or bearing surfaces are required in these ball-bearing swing joints. Balls are of stainless steel, turning in flame-hardened races. The double rows of ball bearings not only provide for easy turning but serve to hold the members of the joint in alignment, eliminating sticking or binding due to end thrust. Easy turning is further assured by the chromium-plated, highly polished packing chamber.



The radial load of each respective joint has figured, in its working pressure, ample safety factor for both internal and external loads and pressures. This joint does not depend for its rigidity on bolted flanges, threaded parts, locking rings, or keys of any type. Any pressure or load is transmitted through the balls and their races. In order for any properly assembled joint to come apart, the pressure of load would have to be equal to the shearing strength of the metal.

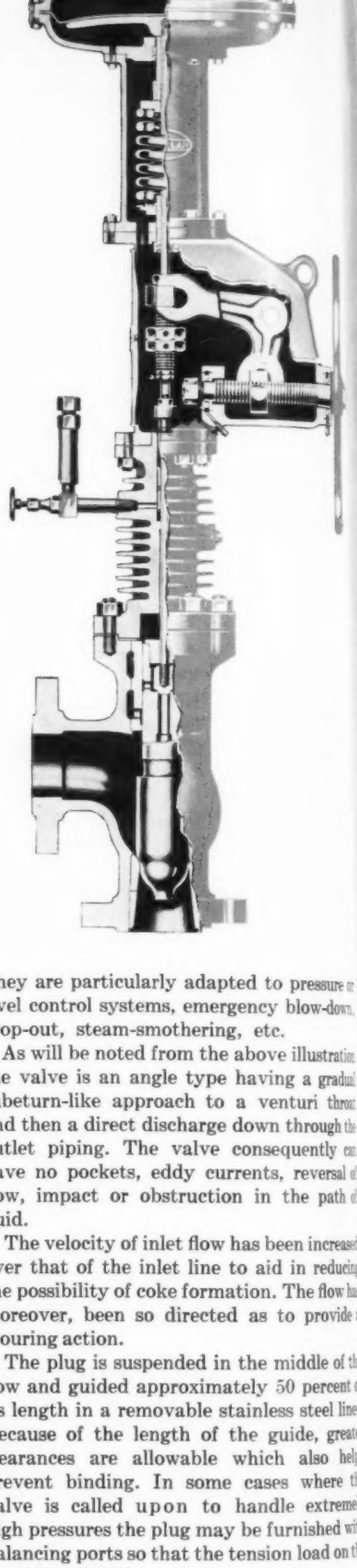
In the center of this page is illustrated a cross section of the firebox in Farrar and



Trefts 150 h.p. all welded oil field boiler which will be shown at Tulsa in the Continental Supply Company Exhibit at the International Petroleum Exposition. This boiler is made with slanted firebox sides, the bottom of the firebox being six inches wider than the top, giving a three inch slant on each side. The outer wrapper sheet also has a two inch slant on each side, thus giving a water leg of increasing width—four inches wide at the bottom and five inches at the top.

This new design provides accelerated water circulation in the hottest part of the boiler to give quicker steaming. Steam bubbles rise vertically through the water instead of along the firebox sides, eliminating all possibility of an insulating steam jacket being formed along the firebox walls. The wide bottom also enables the installation of larger burners to provide a maximum amount of heat for speedy steam generation.

Illustrated at the top right hand side of this page is a cut-away diagram of the Mason-Neilan Series 700 control valve designed for automatic or manual control in hydrocarbon service involving such severe conditions as high temperature and pressure, high pressure drop across the valve, severe coking conditions, flashing of the liquid in the valve, etc.



They are particularly adapted to pressure or level control systems, emergency blow-down, drop-out, steam-smothering, etc.

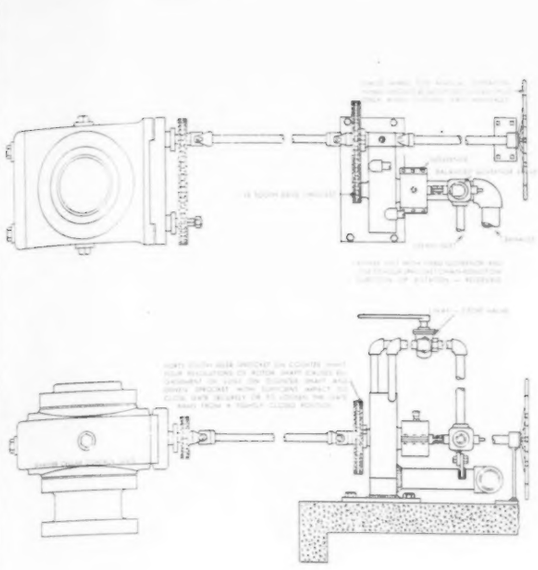
As will be noted from the above illustration the valve is an angle type having a gradual tubeturn-like approach to a venturi throat and then a direct discharge down through the outlet piping. The valve consequently can have no pockets, eddy currents, reversal of flow, impact or obstruction in the path of fluid.

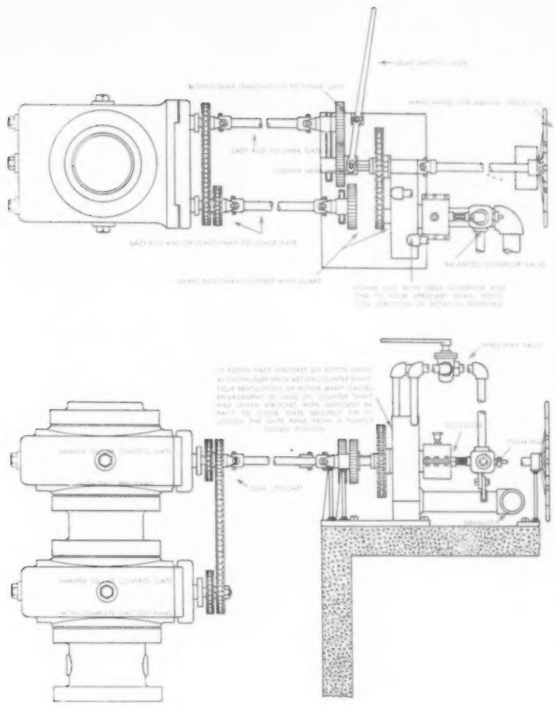
The velocity of inlet flow has been increased over that of the inlet line to aid in reducing the possibility of coke formation. The flow has moreover, been so directed as to provide a scouring action.

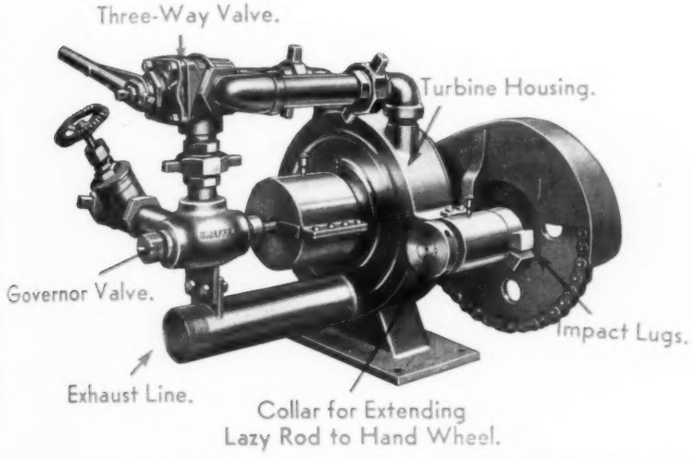
The plug is suspended in the middle of the flow and guided approximately 50 percent of its length in a removable stainless steel liner. Because of the length of the guide, greater clearances are allowable which also helps prevent binding. In some cases where the valve is called upon to handle extremely high pressures the plug may be furnished with balancing ports so that the tension load on the plug is reduced.

The venturi throat is designed with a gradual angle of approach, which eliminates turbulence, and a correct angle of discharge, which is the most efficient means of reduction from the standpoint of capacity, erosion and cavitation.

Air-cooled bonnets are regularly used for service where temperatures exceed 450 deg. F. to reduce the temperature at the packing







gland to a maximim of 150 deg. F. to 250 deg. F.

The packing gland is designed as shown and incorporates the use of premolded solid ring asbestos packing impregnated with graphite, held together and reinforced by synthetic rubber known as Neoprene, which is impervious to hydrocarbons. The two sets of packing rings are separated by a lantern gland, through which a special sealing and lubricating compound is forced by means of the pressure lubricator. This lubricant consists of a special grease with a large percentage of asbestos floats which rebuild the packing in contact with the stem to maintain a positive seal and indefinitely prolong the life of the packing.

These valves are provided with various operating mechanisms, as required by the conditions. They may be entirely hand operated by handwheel or sprocket and chain; they may be operated by a diaphragm as any ordinary control valve; they may combine diaphragm and manual operation; they may be operated by air motors or hydraulic pistons. Power positioners are provided where required. They are thus adapted to all severe refinery conditions.

Bodies are of stress relieved alloy steels, selected to fit the conditions, with approximately 20 percent extra wall thickness over and above A.S.M.E. standards to allow for possible corrosion.

Shaffer Tool Works will exhibit at Tulsa a gate closing engine which is illustrated above. In connection with the illustration of the engine, a diagramatic plan is reproduced showing on the left installation of the gate closing engine to close the upper gate only, and on the right above, a plan for installation of the engine with sliding gear transmission for closing both upper and lower gates.

The power mechanism consists of a turbine which is reversed by operating a three-way valve, and the speed of which is regulated by a governor valve. The turbine rotor shaft is connected through 4-to-1 speed reducing sprockets and chain to a counter shaft, and the drive is extended by lazy rods (torque tubes) which are coupled by universal joints. This arrangement increases the power at the lazy rod to four times that at the rotor shaft.

A two-inch steam line from the boiler connects to a brass gate valve just ahead of the governor valve and thence to the three-way valve. The power device consists of a 16 in. diameter rotor with multiple vanes,enclosed in a steam-tight housing. Bosses in the center of each side of the housing form the bearings for the rotor shaft. The perimeter of this housing is made into an annular space which can be compared with the steam chest of a steam engine. This annular space is divided into two circular pressure-tight compartments surrounding the rotor. Through multiple jets, set at the proper angle, the steam impinges upon the vanes of the rotor. One compartment or steam chest, has the nozzles set to impel the rotor in one direction and the nozzles in the adjacent compartment are set to impel the rotor in the opposite direction. At the three-way valve the steam line is divided into two two inch lines, one of which leads to the compartment for forward motion, and the other line leads to the adjacent compartment for reverse motion.

The nozzles on each side have a slightly less combined area than the two inch pipe. This provides ample velocity of the steam leaving the nozzles and creates maximum torque at rotor shaft. As the power required to close the gates varies under different conditions, a fly ball governor is used to actuate the governor valve.

The Shaffer Gate Closing Engine can be used to close two cellar control gates by using an attachment consisting of a center gear slidingly mounted on an extension of the countershaft, which engages either of two gears mounted on outside parallel shafts.

One of these parallel shafts connects through the lazy rod and universal joints to one of the operating screws on the upper gate and when the center sliding gear is in mesh with the gear on this shaft, it provides the means for closing and opening the rams in the upper gate.

The opposite shaft leads from the transmission unit to an idler sprocket mounted on the other operating screw on the upper gate. A roller chain connects this idler sprocket to a fixed sprocket on one of the operating screws of the lower gate. Thus, by shifting gears with a hand lever, the upper or lower gate may be closed or opened at will.

National Supply Company, some of whose new equipment is illustrated on this and the facing page, is featuring four unit pumpers at the International Petroleum Exposition at Tulsa. Type TU 304-HD 30 TB is illustrated at the top left hand side of this page with a Type CM Superior 2-cycle convertible gas engine. This is a twin crank unit for medium pumping service. Its features incorporate: arc welding construction providing maximum strength and rigidity and less weight in proportion to capacity. The reduction gear ratio together with variation in V-belt sheave sizes, enables the adaptation of high, medium, and low speed prime movers. The frame is made with a short base to which extension bases with slide rails for various types of prime movers are bolted. Changing V-belt sheaves is facilitated by a tapered shaft which includes a locking device and a puller for easy removal. Specifications are given below:

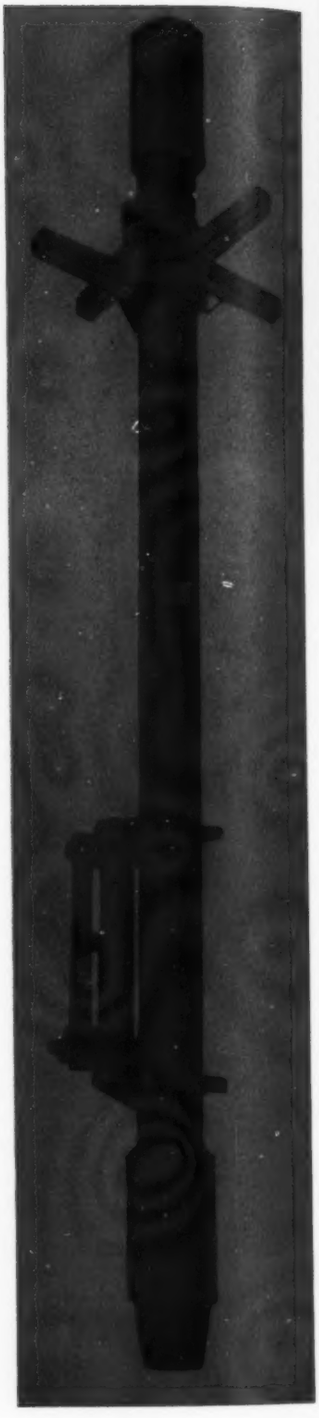
API safe load of walking beam, pounds	12750
Polished rod strokes, inches	33, 40½, 48
Maximum counterweight effect at maximum polished rod stroke, lbs.	8480
Overall counterweight swing, maximum, ins.	48
Reduction gear:	
API peak torque rating at 20 spm., inch lbs.	76500
Overall gear ratio	29.6
Crankshaft diameter at bearings, inches	5
V-belt sheave pitch diameter, inches by number and section of belts	18 x 4c
V-belt sheave pitch diameter, maximum, ins.	26
Well end working centers	6'–0"
Length of base	11'–7"
Width of base, inches	27¾"
Width of base at Samson post, inches	52"
Height bottom of base to top of beam	11'–2"
Walking beam size and weight, CB section	16" x 58 lbs.
Wrist pins, tapered, large diameter by length	2¾"x4⅝"
Weight, regular equipment less extension base and counterweight, lbs.	8100
Weight, RK-36 Crank counterweights, each	1225

Three other unit pumpers are being exhibited by National Supply handling an A. P. I. safe load on walking beam ranging from 3,000 lbs. to 9,125 lbs. with rod strokes from 12 in. to 42 in. The smallest of these three units is $12^{1}/_{16}$ in. wide by 62 in. long on the base and $46^{5}/_{8}$ in. from bottom of base to top of walking beam; the largest of these three types has a base 9 ft. 11¼ in. long by 24¾ in. wide and 9 ft. 7¾ in. high from bottom of base to top of walking beam.

Illustrated at the bottom left hand side of this page is National's Ideal Consolidated draw works which is mounted with the engine and four-speed transmission as a portable unit suitable for drilling to 4,000 ft. with 4½ in. drill pipe. It has a special heavy duty constant mesh transmission providing four hoisting and four rotary speeds, a friction clutch and balanced drum assembly with 16 in. by 44 in. drum. The unit includes 42 in. by $8^{5}/_{8}$ in. steel brake drums water cooled by a spray system.

An interesting feature of National's exhibit is the Ideal Alignascope illustrated at the top right hand side of this page. It has been found that the majority of drilling string failures have been caused by misalignment in some part of the string. The Ideal Alignascope was developed to provide a means of keeping an accurate check on the straightness of the drill pipe, stem, joints and collars, thus making this instrument useful to operators by helping to prevent costly failures due to misalignment of these parts. With this Alignascope the regular drilling crew can quickly survey sections of the drilling string while suspended in the derrick—either when running-in the hole or coming out. They can check the straightness of each stand as a whole, also the individual lengths of pipe and individual joints.

National also has on display a Superior Type CM horizontal single flywheel gas and oil engine with built-in clutch to make a self-contained two-bearing unit for mounting on pumper base or on concrete.



By eliminating an outboard bearing and coupled clutch, or stubshaft, the possibility of alignment difficulty is avoided. Removal of V-belt or flat belt is made easy.

The basic engine design incorporates roller main bearings and roller bearing in clutch, extra heavy single flywheel at operating side and built in water pump. Automatic air starting valve and radiator is available. A convertible oil engine runs on crude.

Other Superior convertible gas and oil engines specially arranged to drive A. C. generator, supply current for pumping with motors on the smaller properties. The oil engine operates on the better grades of crude or on Diesel fuel oil. The design includes extra heavy flywheel and special mixing valve for closer regulation. The V-belt driven generator, usually at 1200 r.p.m., can be equipped with built-in instruments and voltage regulator, all wired to generator, to eliminate switchboard and its wiring.

The Superior Type DV engine has a 4-in. bore and 5-in. stroke with a continuous load rating of 10 h.p. at 700 r.p.m. Speed range is from 400 to 800 r.p.m. It is designed to meet the demand for a low horse power engine for single well pumpers in the shallower fields. This engine is a self-contained unit complete with radiator and power take-off.

One of the most recent additions to the Superior line is the ORD-6 Diesel engine. It is of the conventional medium speed, 4 cycle, solid injection Diesel type. The engine is designed particularly for drilling service. The six cylinder model has an 8 in. bore 9½ in. stroke and a rated horsepower of 250. The eight cylinder model has the same bore and stroke but 335 rated horse-power.

A second Diesel drilling engine unit is known as Type ID-8 and is a portable unit for rotary and cable tool drilling service. The Type ID is of the medium speed, 4-cycle, solid injection, full Diesel type and is built in six and eight cylinder models. Engine may be equipped with either electric or gasoline engine starting. Both models have a 5½ in. bore and 7 in. stroke; the six cylinder develops from 66 h.p. at 700 r.p.m. to 142 h.p. at 1,500 r.p.m., while the eight develops 88 h.p. at 700 r.p.m. to 189 h.p. to 1500 r.p.m.

National's Ideal HS-20½ rotary machine illustrated at the bottom of this page was designed in anticipation of deeper drilling. Constructed in line with the tendency of modern drilling practice toward higher rotating speeds, the HS-20½ rotary is a heavy duty unit with which unusual flexibility of operation is obtainable.

The gear ratio of 2.76 to 1 permits a wide choice in the selection of rotating speeds by changing the sprocket size. When furnished with a 17-tooth sprocket the rotary is equipped for the conventional rotating speeds. With a 14-tooth sprocket it can be used for high speed drilling with speeds up to 350 r.p.m. Specifications are as follows:

Rated drilling depth	15,000
Maximum rotating speed, r.p.m.	350
Table opening for bit or casing	20½"
Table diameter	51⅝"
Main bearing, number of 3" diameter balls	27
Hold-down bearing, number of 2" diam. balls	24
Gear ratio (table, 69-T; pinion, 25-T)	2.76 to 1
Pinion shaft diameter through both bearings	4.726"
Pinion shaft diameter in sprocket	4.497"
Center of table to center of sprocket teeth (A.P.I. Standard)	53¼"
Sprocket, No. 3 A.P.I. machine-cut teeth	14 or 17
Oil reservoir capacity, gallons	12
Length overall	8' 1"
Height overall	2' 5"
Width over skid base	4' 0"
Width overall	4' 8¾"
Net weight, including sprocket, table bushing and hook, lbs.	9,800

National Supply Company is also exhibiting the Ideal 88 in. travelling block with independently mounted sheaves and the Type M Swivel. The block has five 48 in. roller bearing manganese steel sheaves and a rated load capacity of 300 tons. The sheaves handle 4½ in. line, the upper pin has a diameter of 3½ in., the center pin, 10¼ in. and the lower pin diameter is 7½ in. The block weighs 11,251 lbs. is 9 ft. 8 in. long and 34 in. wide.

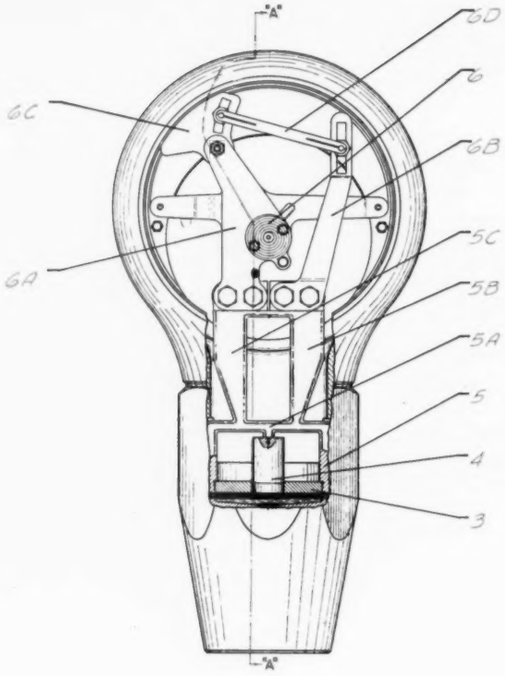
The swivel which is illustrated at the top left hand side of this page has tapered roller bearings, automatically adjusted V-packing for the wash pipe and a preformed weldless bail forged from a solid steel billet. The comparative rating is 250 tons, the fluid passage has a diameter of 4 in. There is a 22 in. hook clearance. The swivel is 10 ft. high 44 in. wide and weighs 6,250 lbs.

Illustrated at the top right hand side of this page is the Ideal power driven 7¼ by 15 in. slush pump. The specifications are as follows:

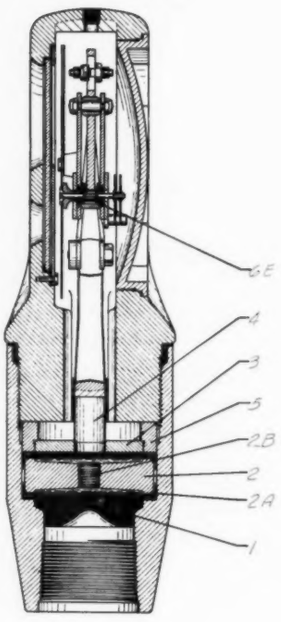
Standard water cylinder, liner bore	7¼"
Smaller liner bores	6¾", 6¼", 5½"
Stroke	15"
Maximum working pressure of fluid cylinder, pounds per square inch	2,500
Maximum rated hydraulic horsepower at 60 r.p.m.	250
Normal speed range, r.p.m.	40 to 60
Diameter of crankshaft	9"
Diameter of piston rod	2¼"
Ratio of gears	5.64
Pitch diameter of V-belt sheave	56"
Number and section of V-belts	15D
Center of pump to center of V-belt sheave	45⅞"
Suction connection	8"
Height, floor to center of suction	14⅝"
Discharge connection	4"
Height, floor to center of discharge	60"
Overall length over skids including motor extension	241"
Overall length over cylinder heads	157"
Width over frame	66½"
Height, floor to top of gear case	37"
Height over fluid cylinders	52"
Height over air chamber	94"
Weight, complete with extended motor skids but less V-belts and sheaves, lbs.	28,975
Weight, 56 in. pitch diam. V-belt sheave, lbs.	1,850

Hewitt Rubber Corp. is exhibiting a new method of rotary hose application that cuts replacement expense and reduces reserve hose inventory cost. Two short lengths of rotary hose are joined with a special leak-proof built-in coupling to form a continuous length. The coupling provides full waterway with no obstruction to retard the flow of mud—and there is no metal exposed to water. In every respect the coupled hose handles and operates exactly the same as the conventional single length, with no loss of flexibility—no writhing or twisting.

In one recent application of Hewitt Multiple-Length Rotary Hose a well was drilled to nearly 13,000 ft. in 51 days—a record for speed



REAR VIEW & SECTION
COVER REMOVED



SECTION "A-A"

ASSEMBLY - TYPE "D" PRESSURE GAGE

The Abercrombie Pressure Gauge illustrated at the top left hand side of this page was developed to damp pulsating pressures and to resist mechanical vibration. It has high visibility and high shock resistance.

The illustration shows the development of these requirements. In order to provide these features it was necessary to depart from the Bourdon tube as a prime mover because its low volume change made fluid damping difficult, and because its relatively small pulling power made it difficult either to provide a heavy movement with shock resistance and long accuracy, or to move a highly visible dial or pointer.

Referring to the illustration, Section A.A., pressure is exerted on the surface of a diaphragm protector (1) which in turn loads a body of fluid in the diaphragm unit (2). This diaphragm unit is composed of a bronze plate with beryllium copper discs clamped on each face by a clamp ring (2-A) and having at its center a tapered threaded plug (2-B) in a complimentary threaded hole. The hole thread is truncated and the plug screwed tight, which provides a long spiral damping passage for the fluid. The diaphragm unit is calibrated and assembled separately with its oil content. Experience has taught the best orifice values for each gauge range. The diaphragm unit communicates the pressure to the surface of the plate (3) and end of pin (4) which are carried by the spring (5). Spring (5) includes a beam (5-A) carrying two upstanding arms (5-B and 5-C) to which the movement (6) is attached. The pressure exerted on pin (4) is a load on the beam (5-A) which deflects a slight amount. The arms (5-A and 5-C) are connected to the beam at points where the tangent to the elastic curve has its greatest slope, and, being normal to the tangent, they move a much larger amount at the point where the movement is attached than the center of the beam where it is loaded by the pin. The plate (3) is not attached to the pin (4), but is designed to deflect at its inner edge an amount approximately equal to the travel of the pin. In this manner there is little or no relative movement of the plate and pin at their adjacent portions, consequently there is no friction between them. This eliminates any undesirable hysteresis effect in the calibration of the instrument and provides a motion with enormous power to drive a movement.

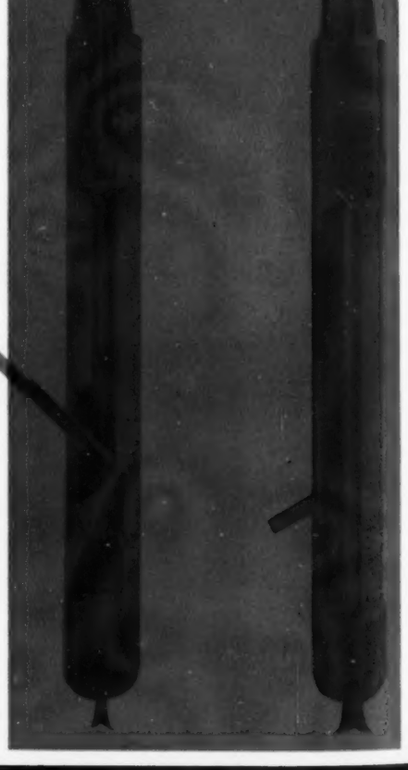
Referring to the rear view, the movement is attached to the left hand arm and a bracket (6-B) fastened to the right hand arm pulls the segment (6-C) through the connecting link (6-D). The segment engages a pinion (6-E) (Section A.A.) to which is fastened the dial. The pinion rotates in ball bearings.

The dial is used to resist mechanical vibration and afford high visability. To provide the internal damping against vibration the case is filled with a light oil and so provides viscous damping on the dial besides keeping the movement in excellent shape. The dial and the oil together provide high visibility since the dial carries large figures and the oil prevents clouding of the unbreakable flexiglas window.

The side wall sampler illustrated at the right is a patented method of taking and recovering through drill pipe large formation samples from the side wall of the bore hole. The tool cuts the time required to complete a well to the desired depth by eliminating unnecessary coring. It recovers any desired number of samples without interrupting normal drilling procedure and these samples ($1\frac{1}{4}$ in. in diameter and 4 to 6 in. in length from $8\frac{1}{2}$ in. to $12\frac{1}{4}$ in holes and $1\frac{1}{8}$ in. in diameter and 4 to 6 in. in length from $7\frac{1}{2}$ in. to $8\frac{1}{2}$ in. holes) are sufficiently large to furnish a complete analysis of the formation sampled. Length of the samples is dependent upon the length of core tube used. The tool was developed by Houston Oil Field Material Company, and is being shown at the Tulsa show.

Inside and outside views of the tool are illustrated here. The outside view shows the core, or sample tube, in the position at which it contacts the wall of the hole. The inside view (area of the sample in red) shows the tube in position after the lowering of the tool has caused it to pierce the hole wall and take the sample. The tool is run on drill pipe and the sample cut and recovered through the drill pipe in connection with a wire-line retractable core barrel. Rotation and circulation of the drilling fluid is permitted during the operation, except when actuating the drill pipe to obtain samples . . . this being done by the use of a special circulation head with safety wire-line stuffing box provided for use with the sampler.

A flash welded, unitized drill stem is one of the new tools developed by the Hughes Tool Company which will be on exhibit at the Oil Show. It is designed to reduce connections to a minimum and provide a drill stem with integral tool joints without compromising in the physical properties that are best suited respectively for tool joint and drill pipe. Having no threads there can be no "last engaged thread" failure, thread leaks or washouts. The flash welding process is automatically controlled, differential cooling is elimi-



nated and impurities are forced out as a result of the considerable pressure under which the two members are joined.

Hughes Unitized Drill Stem has been developed to provide an integral tool joint and drill pipe assembly wherein the members are made of the materials best suited for each.

A study of the problem, and actual experience with various designs, indicated that this goal could be reached commercially within reasonable space limitations only by the use of the welding process.

The pipe as received from the mill is ready for welding, except for the cleaning of a short portion of the outer surface just behind the upset where one of the electrical contacts is made. The other contact is made on the tool joint.

The pipe and tool joint pin (or box) are mounted in the welding machine which holds the two pieces in proper alignment. Upon closing the electrical circuit, the heating period begins, during which an arc is drawn between the end of the tool joint and the end of the pipe. This brings both members to welding temperature very rapidly.

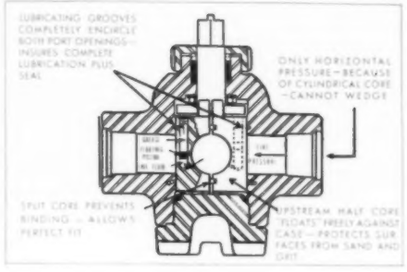
When the work has reached the correct temperature, the current is turned off automatically and the two members are quickly brought together at a pressure sufficient to force out of the joint all of the molten metal, thus uniting the two pieces.

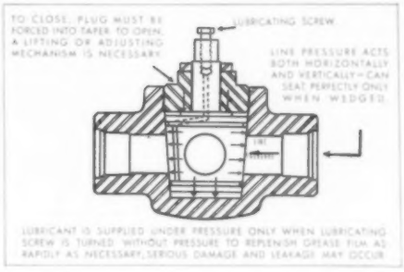
Before removing the finished piece from the machine, a punch shears off the excess metal that has collected in the bore during the welding process, while that adhering to the outside of the joint is removed later by means of a machining operation.

After welding, the joint is tested for alignment before passing to the final machining operation.

The heating method employed in flash welding, coupled with the speed of the operation (it takes less than three minutes to complete a weld, floor to floor), results in limiting the heated zone to a narrow band of metal which, in the case of 4½ in. internal flush drill stem, is less than 1½ in. wide. Only this section, approximately half of which is in the tool joint and the other half in the pipe, has been heated above the temperature of the prior metallurgical treatment.

The metal at the plane of contact between tool joint and pipe has been heated just to the melting point (slightly in excess of 2750 deg. F.), but the temperature falls off rapidly at each side of this plane. It has been determined that the maximum temperature about ¾ in. from the weld is not over 850 deg. F., and at the fade out of the tapered elevator shoulder into the pipe body it does not exceed 350 deg. F. at any time.


LUBRICATING GROOVES COMPLETELY ENCIRCLE BOTH PORT OPENINGS—INSURES COMPLETE LUBRICATION PLUS SEAL
ONLY HORIZONTAL PRESSURE—BECAUSE OF CYLINDRICAL CORE—CANNOT WEDGE
SPLIT CORE PREVENTS BINDING—ALLOWS PERFECT FIT
UPSTREAM HALF CORE "FLOATS" FREELY AGAINST CASE—PROTECTS SURFACES FROM SAND AND GRIT


TO CLOSE, PLUG MUST BE FORCED INTO TAPER TO OPEN. A LIFTING OR ADJUSTING MECHANISM IS NECESSARY
LUBRICATING SCREW
LINE PRESSURE ACTS BOTH HORIZONTALLY AND VERTICALLY—CAN SEAT PERFECTLY ONLY WHEN WEDGED.
LUBRICANT IS SUPPLIED UNDER PRESSURE ONLY WHEN LUBRICATING SCREW IS TURNED. WITHOUT PRESSURE TO REPLENISH GREASE FILM AS RAPIDLY AS NECESSARY, SERIOUS DAMAGE AND LEAKAGE MAY OCCUR

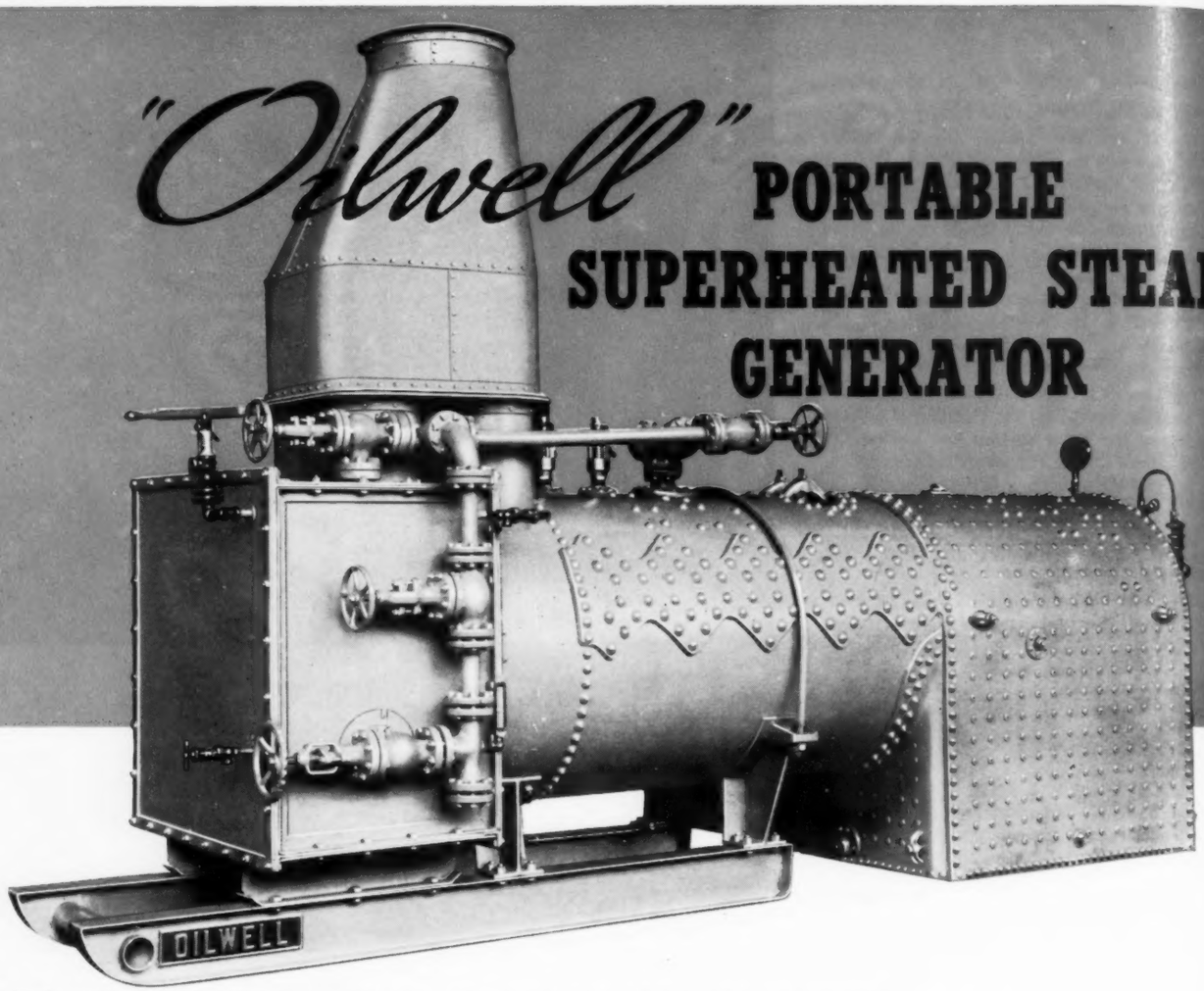
On the upper right hand side of this page may be seen photograph and diagram of the new Mission plug valve on exhibition at Tulsa. The valve was designed to avoid difficulties arising from failure to maintain a constant lubricating seal around the valve core when the valve is closed. As is well known the failure to maintain this seal permits grit to work into the space between valve core and body, making the valve difficult to operate and subject to excessive wear. The principle is illustrated diagramatically directly under the photograph of the valve which has a drop-forged, non-corrosive, super-surfaced, cylindrical core. The split core permits a perfect fit and prevents binding. Under line pressure the upstream half floats—and since all the pressure and friction are on the downstream side of the valve, friction is cut to a minimum.

The Hunt side wall sampler exhibited at Tulsa and illustrated on the right is designed to recover side wall samples by means of a wire line retractable core barrel run in through the drill stem and retracted by means of a conventional wire line overshot. After drilling to a pre-determined depth the well may be electrically logged and side wall cores obtained of all possible producing formations.

As illustrated the Hunt side wall sampler is provided with a conventional drilling bit to permit drilling out bridges or loose formation if necessary. The tool is designed to permit circulation while going in or coming out of the hole.

With the core tube held firmly against the side wall of the hole by means of the spring actuated deflector arm, the drill stem is lowered slowly about one foot to force the core tube into the formation. After obtaining a side wall core, upward movement of the drill stem retracts the core tube to its original position, and core barrel is then removed from the tool by means of a wire line overshot.

"Oilwell" PORTABLE SUPERHEATED STEAM GENERATOR



THE "Oilwell" Portable Superheated Steam Generator comprises a steam generator of large-firebox, short-tube construction, a smokebox superheater, and a unitized piping assembly. All three are combined in one compact unit, mounted on steel skids for portability. Note advantages listed at the right.

- ★ *Provides superheated steam safely and economically.*
- ★ *Provides more power with less weight.*
- ★ *Increases efficiency through better all-around performance.*
- ★ *Reduces stack temperatures through better heat absorption.*
- ★ *Reduces moving and installation costs.*
- ★ *Reduces original investment.*
- ★ *Reduces operating cost.*

SPECIFICATIONS

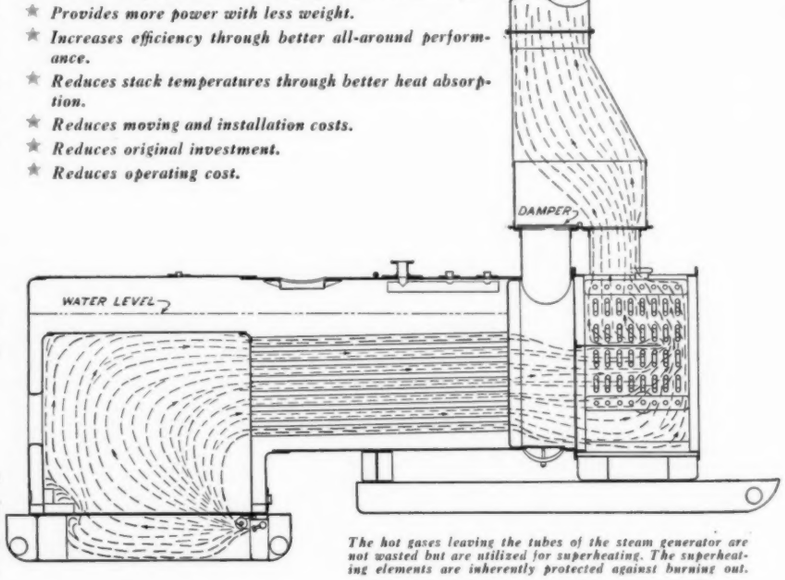
Unit No. 1

Weight, complete (including stack)* ...34,000 lbs.
Steam Working Pressure.350 lbs./sq. in.
Recommended Operating Load (Continuous) ...7900 lbs. of water per hr. superheated to 600° F.=300 B.H.P.
Demonstrated Peak Load (Intermittent) ..9500 lbs. of water per hr. superheated to 650° F.=375 B.H.P.
Boiler Horsepower .....One B.H.P.=33, 479 B.T.U.

Unit No. 2

Weight, complete (including stack)* ...25,900 lbs.
Steam Working Pressure.350 lbs./sq. in.
Recommended Operating Load (Continuous) ...4800 lbs. of water per hr. superheated to 580° F.=180 B.H.P.
Demonstrated Peak Load (Intermittent) ..6000 lbs. of water per hr. superheated to 630° F.=225 B. H. P.

*The No. 1 and No. 2 Generators may be dismantled to facilitate transportation in the field, in which case the greatest weight of any single unit or piece is 23,200 lbs. and 18,200 lbs. respectively.



The hot gases leaving the tubes of the steam generator are not wasted but are utilized for superheating. The superheating elements are inherently protected against burning out.

OIL WELL SUPPLY COMPANY

"Oilwell"

Executive Office DALLAS

NEW YORK
LOS ANGELES
LONDON

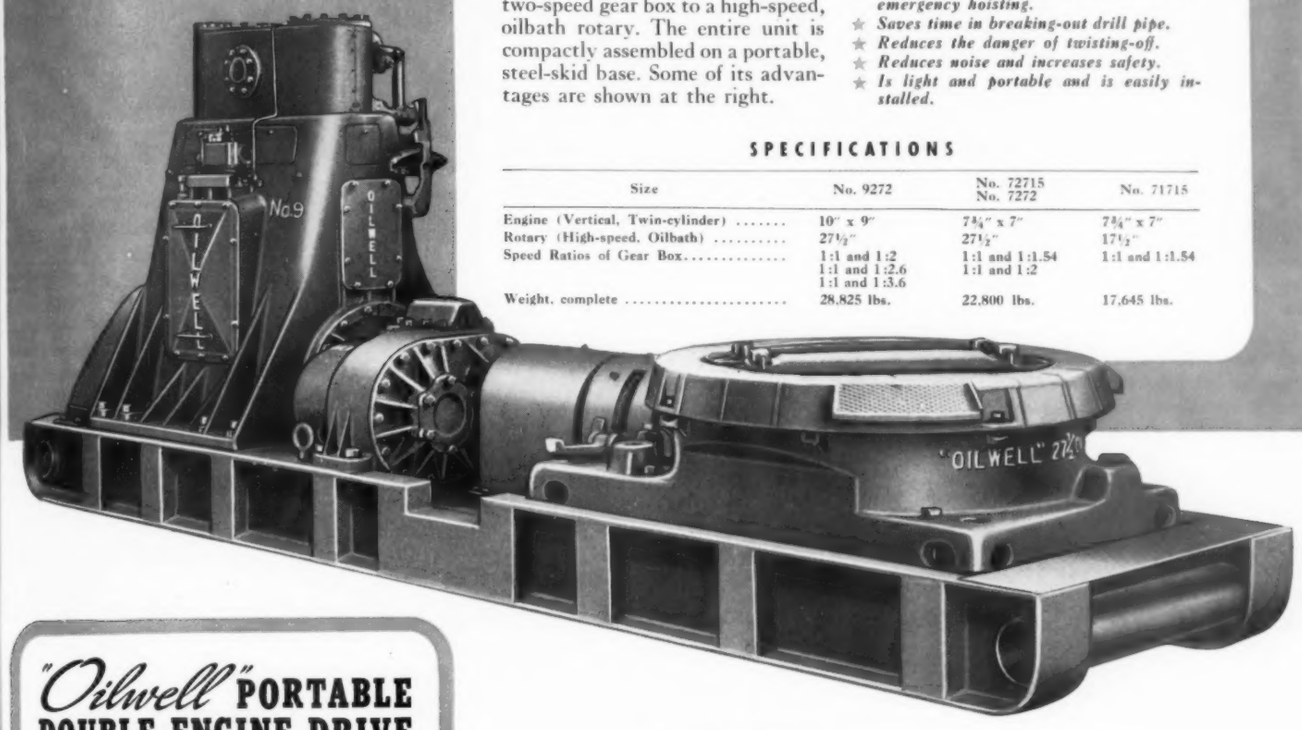
"Oilwell" ROTARY DRILLING UNIT

THE "Oilwell" Rotary Drilling Unit consists of an efficient, twin-cylinder, vertical steam engine direct-connected through a two-speed gear box to a high-speed, oilbath rotary. The entire unit is compactly assembled on a portable, steel-skid base. Some of its advantages are shown at the right.

- ★ *Eliminates wear and replacement of rotary chain and sprockets.*
- ★ *Reduces wear-and-tear on the rotary, hoist and hoisting engine.*
- ★ *Provides an auxiliary prime mover for emergency hoisting.*
- ★ *Saves time in breaking-out drill pipe.*
- ★ *Reduces the danger of twisting-off.*
- ★ *Reduces noise and increases safety.*
- ★ *Is light and portable and is easily installed.*

SPECIFICATIONS

Size	No. 9272	No. 72715 No. 7272	No. 71715
Engine (Vertical, Twin-cylinder)	10" x 9"	7¾" x 7"	7¾" x 7"
Rotary (High-speed, Oilbath)	27½"	27½"	17½"
Speed Ratios of Gear Box.....	1:1 and 1:2 1:1 and 1:2.6 1:1 and 1:3.6	1:1 and 1:1.54 1:1 and 1:2	1:1 and 1:1.54
Weight, complete	28,825 lbs.	22,800 lbs.	17,645 lbs.



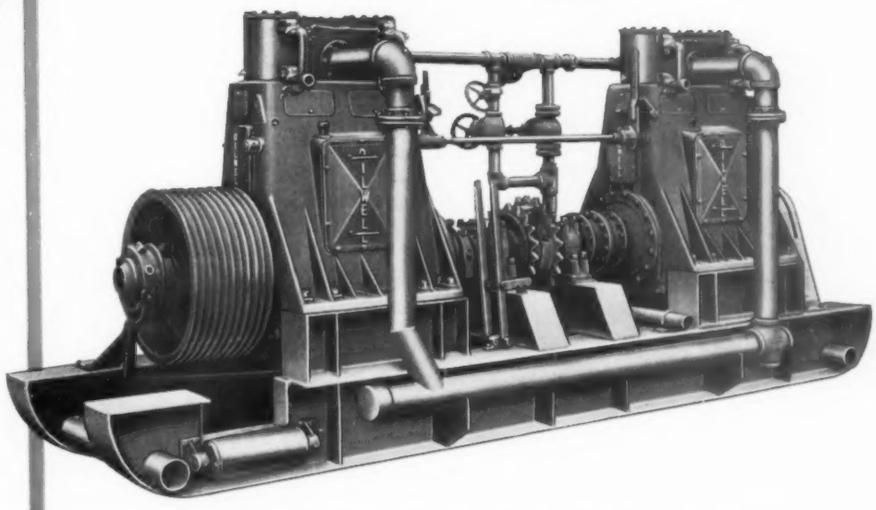
"Oilwell" PORTABLE DOUBLE ENGINE DRIVE

THE "Oilwell" Portable Double Engine Drive is a compact assembly including two vertical steam engines with complete steam and exhaust manifolding, power take-offs, and the control levers and valves needed for operating the engines either individually or in tandem. Its unitized construction facilitates moving and installation. Its applications are:

- ★ *Hoisting with one engine or with both.*
- ★ *Driving a power pump with one engine while driving the rotary through the hoist with the other engine.*
- ★ *Using each engine for an individual pump drive when the rig is equipped with an "Oilwell" Rotary Drilling Unit.*

SPECIFICATIONS

Size	No. 7	No. 9
Engines (Two, Twin-cylinder, Vertical) ...	7¾" x 7"	10" x 9"
H. P. at 400 r.p.m. (Two Engines, 83½ cut-off):		
325 lbs./sq. in. steam pressure at the throttle	720	1420
225 lbs./sq. in. steam pressure at the throttle	500	995
Weight of Each Engine ..	6,250 lbs.	11,180 lbs.
Weight of Complete Drive.	25,700 lbs.	42,300 lbs.



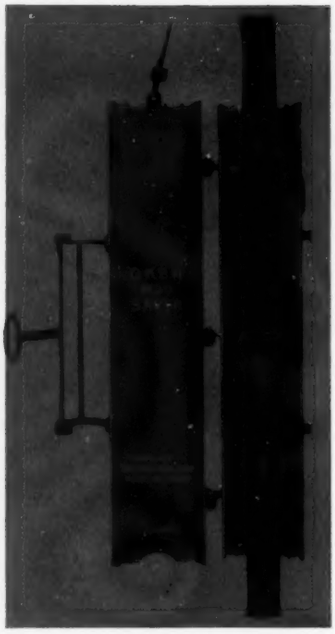
• *Send for Complete Information.*

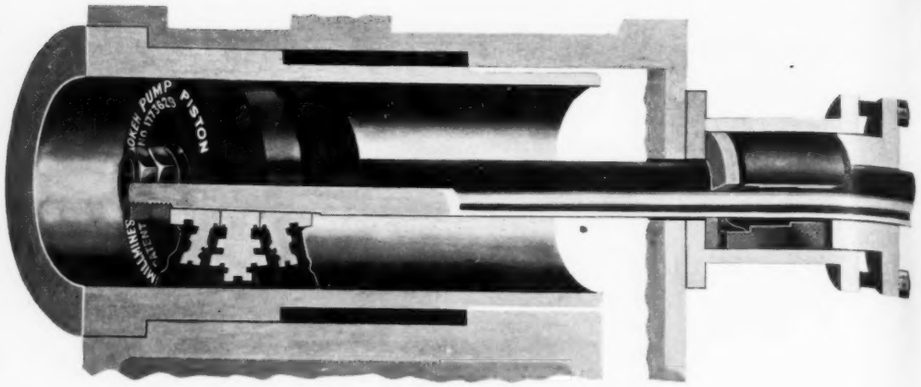
"Oilwell"

OIL WELL SUPPLY COMPANY

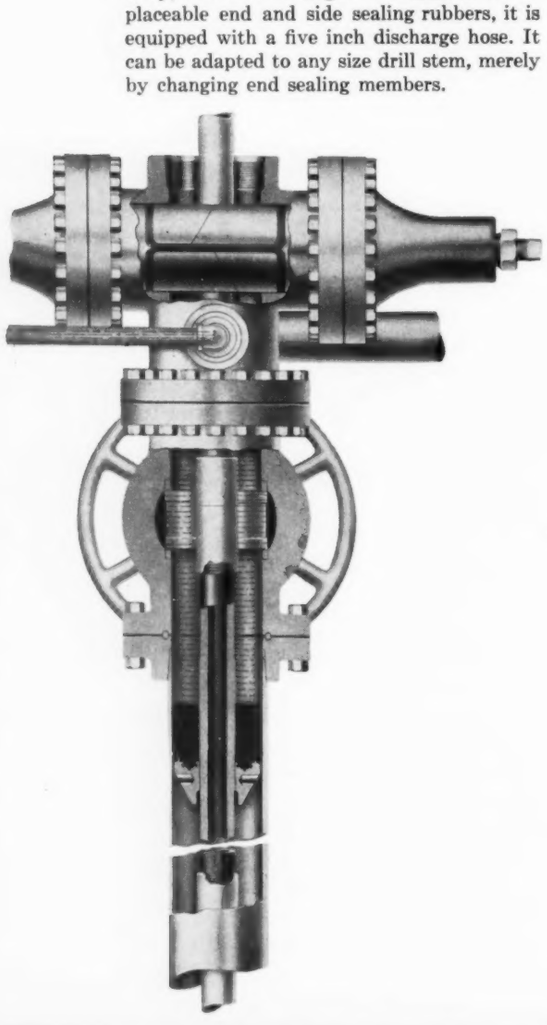
Executive Office DALLAS

NEW YORK
LOS ANGELES
LONDON





Three of the illustrations on this page show the characteristics of equipment being featured by the Texas Rubber and Specialty Corp. at the International Petroleum Exposition. At the top left hand side of this page is illustrated a mud saver which is intended to be suspended in the derrick of a drilling well near the rotary table. When coming out of the hole with a wet string, the mud saver clamps around the stem, inclosing the tool joint before it is broken out. By this procedure, the drilling mud is trapped in the bucket and returned through the swivelled exhaust hose into the mud ditch. The tool has a 10 in. metal body, five feet in length. In addition to replaceable end and side sealing rubbers, it is equipped with a five inch discharge hose. It can be adapted to any size drill stem, merely by changing end sealing members.



At the bottom, left is illustrated Texas Rubber's blowout preventer tester based on the principle that it confines fluid to a given space sealing against the casing and the drill stem sub. The drill stem is raised off bottom and slips set. Stem is broken out, tester made up on a single or double and the assembly lowered until rubber head is stopped below master gate valve. The stem is hung on elevators so that weight registers on weight indicator. Rams of blowout preventer are closed and the pump connected to the fill up line, shown in the diagram with red line running into assembly. Water is pumped in at the pressure that it is desired to test and the rubber seals at bottom while the preventer seals at top, while the weight indicator shows the pressure being exerted. Any leaks in the preventer will show up at this point.

At the top right hand side of this page is illustrated Texas Rubber and Specialty's high pressure, one piece piston. The piston body is composed of a series of saucer shaped plates making metal to metal contact with each other and with the pump rod. These plates are of chrome nickel steel tested to withstand severe pressures. The piston body is mounted on the rod with a ground joint seat to prevent loosening. The plates have a series of knobs on the concave side to prevent the rubber from cold-flowing under pressure. The rubber on these pistons is applied at 1,000 lbs. and 273 deg. F.

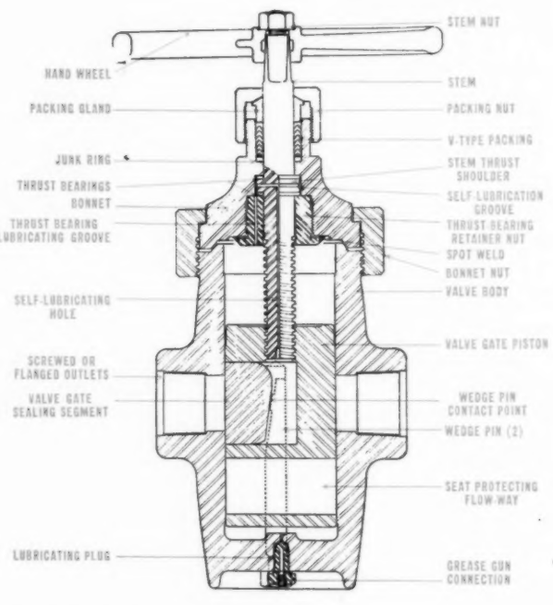
Other features of the Texas Rubber exhibit not illustrated on this page are the swivel packing, polished rod packing and pump rod packing.

Oil Center Tool Company's new Type "V-3" double seal cylinder gate valve is illustrated at the bottom right hand side of this page. According to its designers, A. J. Penick and K. T. Penick, this valve employs an entirely new means of sealing and lubrication.

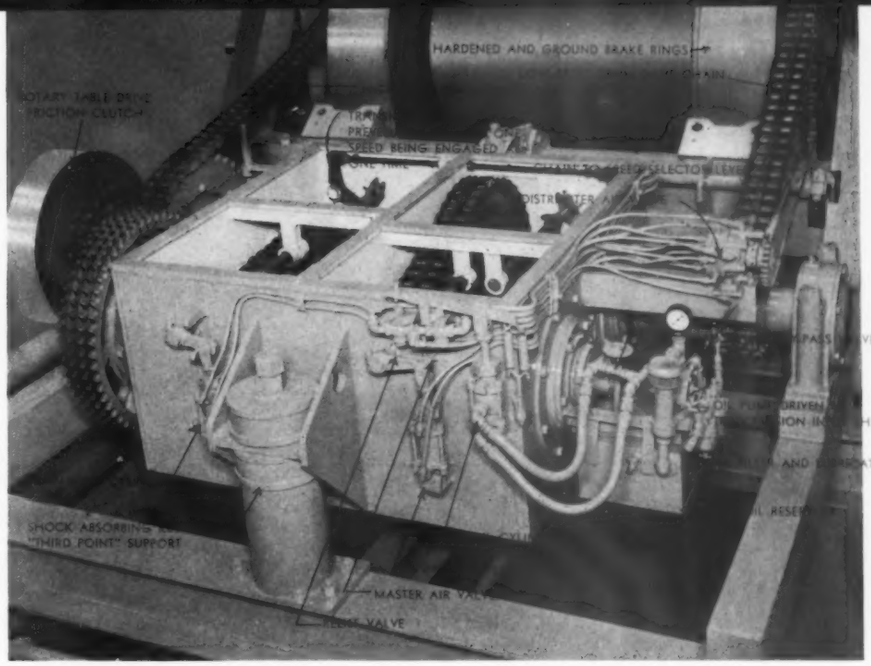
As shown in the cross-section view presented herewith, the gate of the O-C-T valve is cylindrical and travels in the round bore of the valve body. A tapered sealing segment is inset in one side of the gate piston. A taper is machined on the back side of this segment to mate with the taper on two wedge pins which are attached to the bottom of the valve body and which extend into the gate piston. Upon closing the gate, the tapered side of these pins contacts the taper on the sealing segment at its center point, resulting in an equalized outward thrust in two directions; i.e., against the sealing segment in one direction and against the gate piston in the opposite direction. Thus, the convex sealing surfaces of both the segment and piston are forced into sealing contact with the inside wall of the valve body.

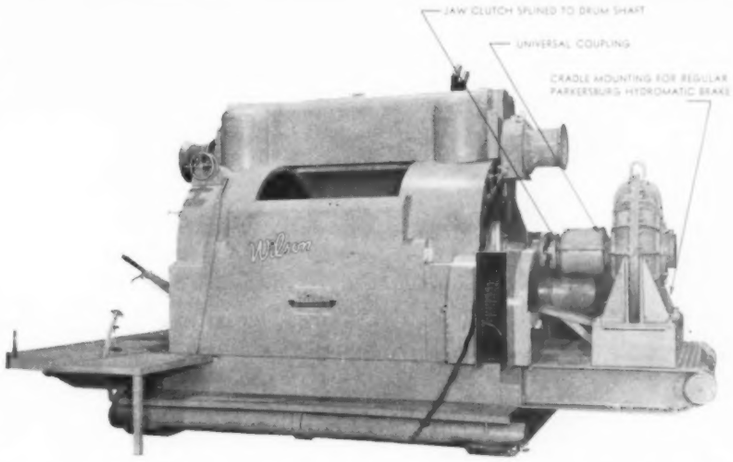
A flow way, or conduit, is drilled through the lower part of the valve piston which is raised opposite the flow outlets upon opening the valve.

Outstanding at the Wilson Manufacturing Company's exhibit at the Petroleum Exposition are the three items illustrated on the facing page. On the left hand side is illustrated the internal expanding, self-energizing shoe type clutch which has a hardened and ground brake surface with a Brinnell hardness of 500



TAPPED IN DRUM END
LOCK BOLT HOLE IN CLUTCH SPIDER
WATER INLET AND OUTLET
SINGLE POINT ADJUSTMENT FROM ANY OF THESE 3 POINTS.
SHOES EXPAND ON BOTH ENDS—GIVING MAXIMUM HOLDING POWER AND LONGEST WEARING LIFE.
OILLESS BEARINGS REQUIRE NO LUBRICATION
CLUTCH RING
BRAKE RING
COUNTERWEIGHTS BALANCE AGAINST CENTRIFUGAL FORCE
SPROCKET BOLTS TO THIS SPIDER
PIPE FOR CIRCULATING COOLING WATER
WATER COOLING SPACE BETWEEN RINGS COOLS BOTH BRAKE AND CLUTCH
HARDENED CAM
5/8" REGULAR BRAKE LINING
BALL BEARING SHIFTER YOKE





to 600. Rated torque capacity is 1,000,000 inch-pounds, a capacity sufficient to pull $1\frac{1}{4}$ in. drilling line in two on the second layer of the drum. This tremendous capacity is made possible by the internal expanding shoe type clutch where shoes expand at both ends, with a compound leverage system and a water cooled clutch surface which prevents the clutch from burning. Moreover, if the air supply should fail the clutch can be operated by hand and is so arranged that lock pins can be inserted in a few minutes in the event that the clutch should fail for any reason.

On the top right hand side of this page is shown the Wilson air control transmission showing the shift locking mechanism.

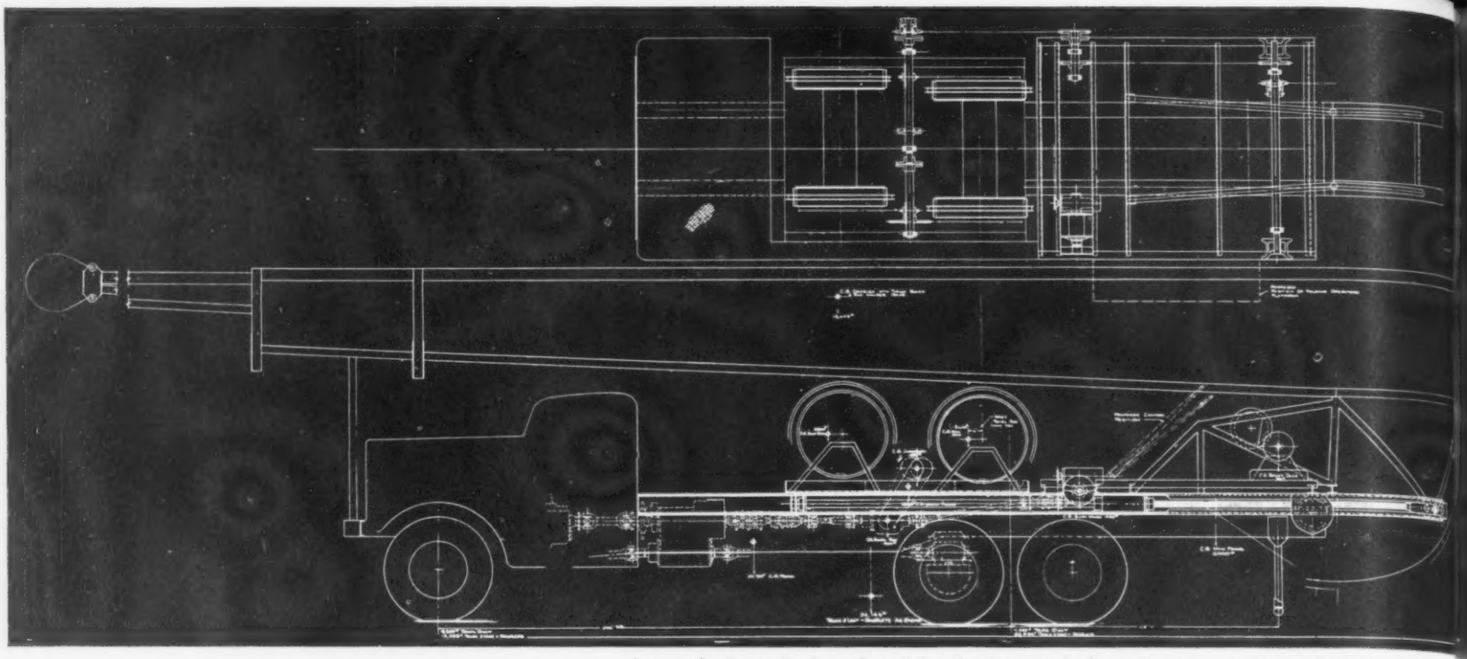
The transmission has an all-steel case of heavy boiler plate, arc welded together with high tensile strength welding rod. This transmission is supported in the frame of the draw works on two SKF Spherical Roller Bearings in steel housings, and with the third point of support a shock absorbing rubber mounting.

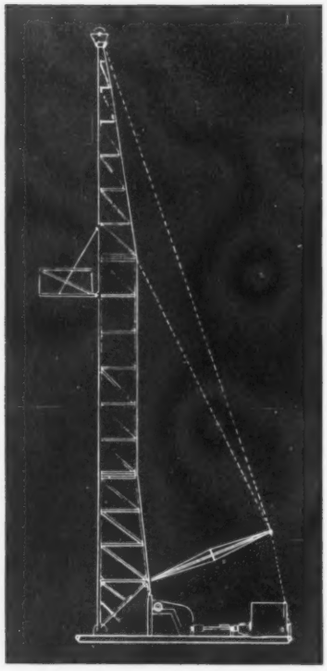
All shafts are of heat treated alloy steel, with splines cut into the solid metal of the shaft and no loose keys. They are turned, then ground on precision grinding machines. All sprockets and clutches are case hardened or heat treated alloy steel. All chains in the transmission are of the same size and interchangeable, double strand Diamond Chain with an actual average breaking strength of more than five times the rated capacity.

This shift locking mechanism consists of a gear type oil pump driven by the transmission input shaft. The oil from this pump is delivered to a cylinder mounted on the outside of the transmission case. In this cylinder is a piston, and this piston is connected to a lever and so arranged that when the pump delivers oil to the cylinder and forces the piston upward, locking arms engage the clutch shifting mechanism so that the clutches cannot be shifted as long as the piston is pushed upward in the cylinder.

In the air operated transmission shift, the same type of gear pump and oil cylinder is used, but the piston controls a master air valve which shuts off the air as long as the input shaft of the transmission is running. When the transmission input shaft stops, the pump no longer delivers oil to the cylinder, and as the by-pass valve permits this oil to return to the storage, a spring pulls the piston down into the cylinder and opens the master air valve which, in turn, causes the air cylinders to shift speeds in accordance with the speed pre-selected by the operator. In this transmission shift the driller turns the speed selector handle to the next speed which he expects to use while the rig is running, and when the driller shuts off the rig the speed automatically changes to the new speed that he has selected, without clash or noise, and when the rig is started up again it is in the speed which he has selected.

Just below the illustration of the air control transmission is an illustration of Wilson's rig in which the guard of the hydromatic clutch and drive coupling has been removed to show this arrangement. Tests reveal that where the hydromatic brake was mounted directly on the drum shaft it took about 45 seconds to drop the empty blocks when pulling 90 ft. stands of pipe, whereas if the hydromatic brake could be disconnected the same blocks would drop in about 15 seconds, which meant a saving of 30 seconds for each 90 ft. stand of pipe when coming out of the hole, and would save as much time as if an additional 300 h.p. engine had been used in coming out of the hole. By setting an ordinary hydromatic brake in a welded steel cradle as shown in the illustration and mounting a double step jaw clutch and a flexible coupling between the drum shaft and the hydromatic brake, the clutch can be disconnected completely when coming out of the hole, with a considerable saving in time, and wear and tear on the hydromatic brake itself. It was originally contemplated that the clutch would be left "in" during the entire time of going into the hole, but in practice it was found desirable to engage the clutch only when lowering the pipe and to disengage it when hoisting the empty blocks. It was found that by doing so about ten seconds per stand could be saved in hoisting the empty blocks and with much less power required from the engine. The clutch lever has been located conveniently to the driller and the clutch disengaged to permit free hoisting of the empty blocks. It is estimated that this device will save one hour's time on a round trip at 8,000 ft.





A new device to be introduced for the first time to the industry at the 1940 International Petroleum Exposition at Tulsa is a 100 percent portable 84 ft. telescoping servicing derrick mounted on a truck. It will be shown by the Franks Manufacturing Corp., the designer and manufacturer.

The derrick is designed to service approximately 100 wells per unit in the average field on the pump and thus it eliminates the need for individual permanent servicing derricks over each well.

The derrick is of the telescoping open face type made in two sections, capable of being extended and locked in 84 ft. position and in a 50 ft. position (for extremely heavy pulls). The telescoped dimensions for over-the-road travel are 45 ft. overall length, 8 ft. overall width, and 12 ft., 6 in. overall height with tubing platform folded across the top of the derrick. Guy lines and blocks may be carried strung without an increase in these dimensions. The derrick may be furnished for either single or double drum winches.

The derrick which is diagramatically illustrated at the top of this page is designed for a gross capacity of 100,000 lbs. in accordance with API design formula. The front legs in both sections are constructed of 5 by 5 by 5/16 Silicon steal angles and the rear legs of 3½ by 3½ by 5/16 Silicon steel angles. Interior bracing is of structural steel shapes. The crown block is integrally mounted and is provided with three 18 in. diameter heat treated roller bearing and centrally lubricated sheaves. Leveling screws are provided in the two front legs of the derrick.

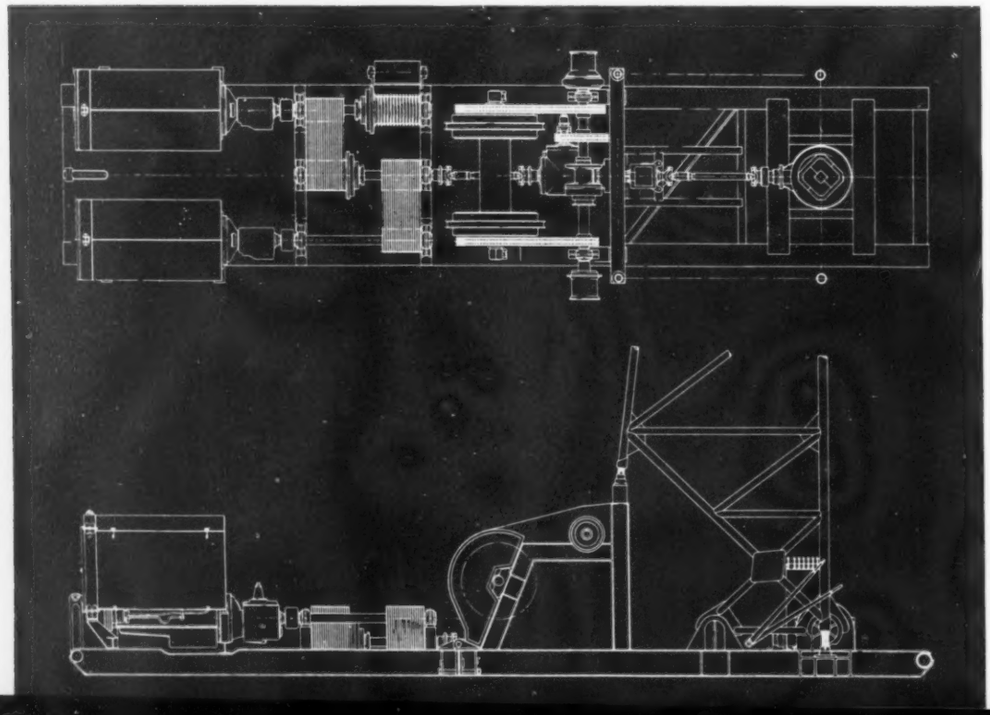
An adjustable height tubing platform is provided to permit pulling rods and range two tubing in doubles. Rods may be hung by means of a built in rod basket crane. Capacity of the tubing platform is 6500 ft. of 2½ in. tubing.

The derrick is raised and extended by a built-in mechanical raising and extending device which includes two large diameter raising screws of SAE 3140 steel, operated by two ball bearing mounted, internally lubricated, bronze alloy drive nuts, and a small extending winch of 45,000 lbs. ultimate capacity. The arrangement permits positive control of the raising and extending operation at all times, and facilitates the rapid erection of the derrick.

The derrick can be locked in either the 84 ft. or 50 ft. position by means of a pawl and lug mechanism, which is operable from the ground. The locking of the derrick in either position is quick and positive. The derrick joint between the two sections is tapered for rigidity and for accurate alignment of the two sections.

Total time for erection does not exceed seven minutes, including raising, extending and locking. If dead men have been placed, the total time of erection including guying should not exceed twenty minutes.

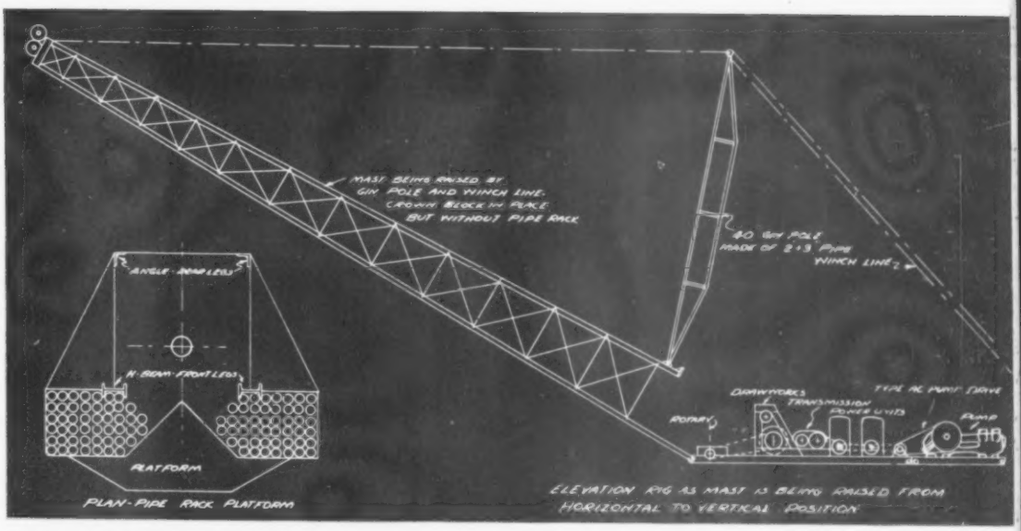
On the left and bottom of this page is illustrated in diagram Franks Manufacturing Corporation's SA Models of portable skid rotary drilling units designed according to the maker to bring the economies found practicable in Franks truck and trailer-mounted "slim-hole" units to medium depth standard drilling. The units include drawworks, catheads, two engine power plants with facilities for compounding to any drive, pump drive including drive pulley and "V"

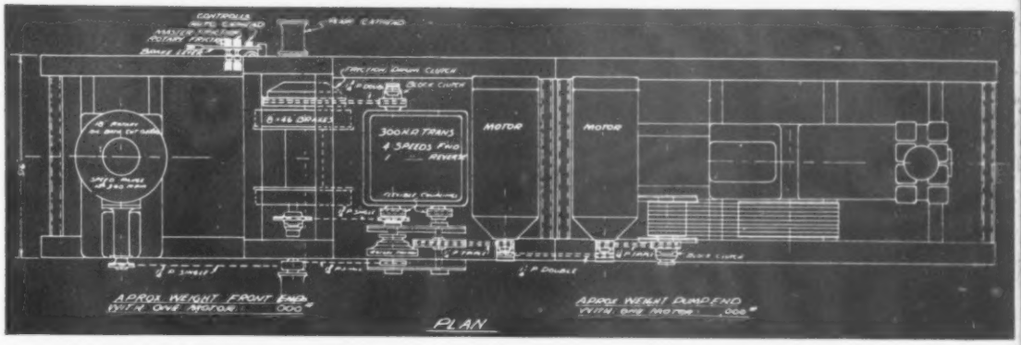


belts, propeller shaft rotary table drive, rotary table, master bushings, derrick and self-contained boom raising device, crown block and stacking board, swivel and kelly, all unitized for economy of operation.

This rig has its own self-raised derrick, illustrated center left, with 5-sheave integral crown block and stacking board, which is raised in one piece. Maximum of one hour is required for assembly and raising. The derrick is constructed in two or three sections for portability and is completely friction clutch driven including final drive friction drum clutch. The rotary table has the drive under the drawworks and floor, eliminating the impediment of side chain drive.

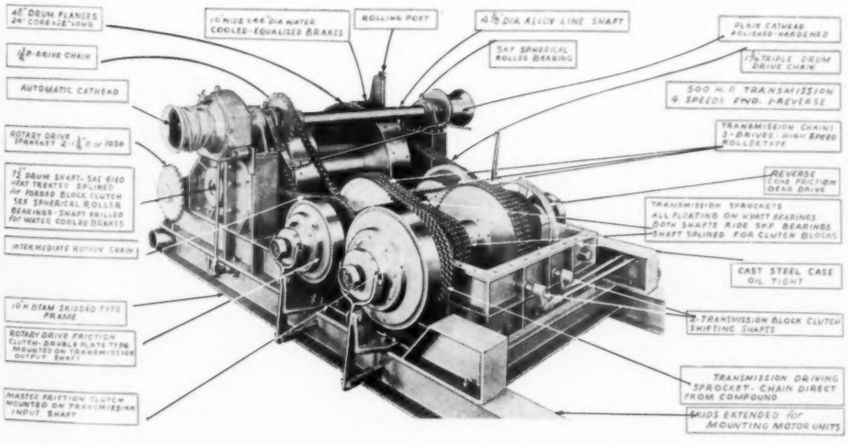
The adjoining blue print explains how the Brewster CR Series portable drilling rig with mast type derrick is assembled, as well as showing most of the important dimensions. At the top is illustrated an elevation and plan of the pipe rack platform and the 85 ft. derrick together with crown block and pipe rack. Below is a plan showing the elements that make up the two main units of the rig itself. The standard set-up includes the rotary, drawworks, oilbath transmission and drawworks motor, all mounted on one set of skids. On the other skid is mounted the pump motor, pump drive and pump. The skids are placed end to end and the two motors compounded. An optional arrangement is to have both motors and pump drive mounted on the drawworks skid, and have the pump only mounted on a separated skid. With this Brewster rig it is possible to start drilling operations only six hours after all equipment has arrived on location. In assembling, the drawworks unit is the first to be placed. Then the pump unit is skidded into position. The derrick is then attached and raised as a single unit with the aid of the gin pole that is furnished and a winch line. Brewster portable rigs are available in two sizes that are recommended for drilling to 4000 ft and 5000 ft. The crown block has a capacity of 250,000 lbs. with four 30 in. roller bearing sheaves and one catline sheave. The 85 ft. derrick type mast also has a capacity of 250,000 lbs. At the bottom of this page the rotary drive for this portable rig is illustrated with principal features marked in red.

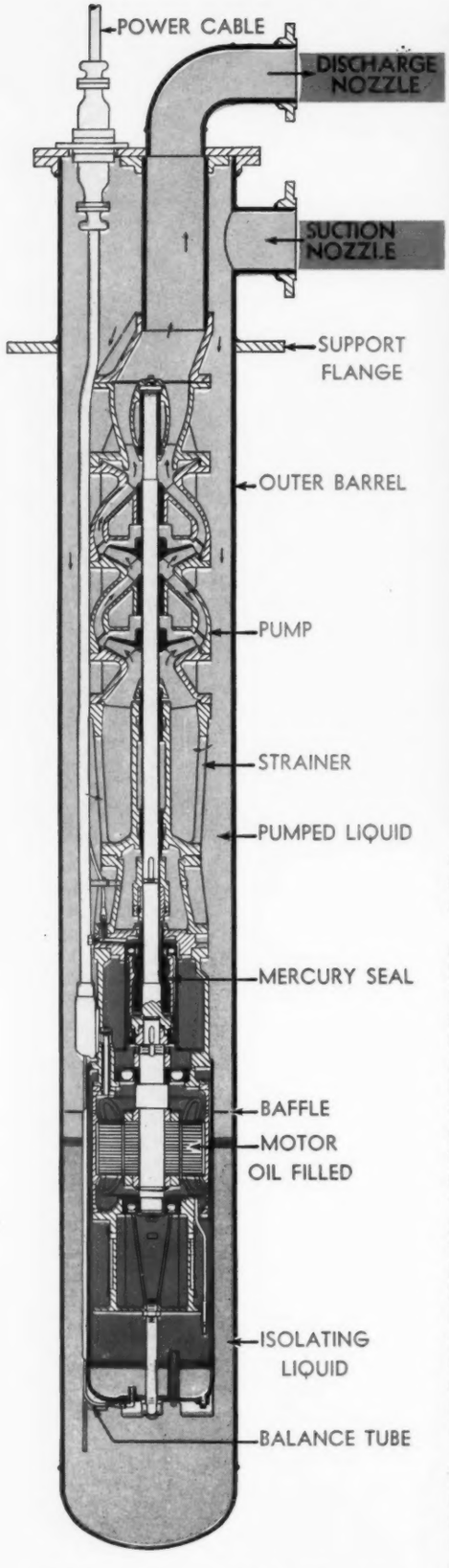

MAST BEING RAISED BY GIN POLE AND WINCH LINE. CROWN BLOCK IN PLACE BUT WITHOUT PIPE RACK
40' GIN POLE MADE OF 2+3 PIPE
WINCH LINE
ANGLE IRON LEGS
H BEAM FRONT LEGS
PLATFORM
PLAN - PIPE RACK PLATFORM
DRAWWORKS
TRANSMISSION
POWER UNITS
PUMP
ROTARY
TYPE AC PUMP DRIVE
ELEVATION RIG AS MAST IS BEING RAISED FROM HORIZONTAL TO VERTICAL POSITION



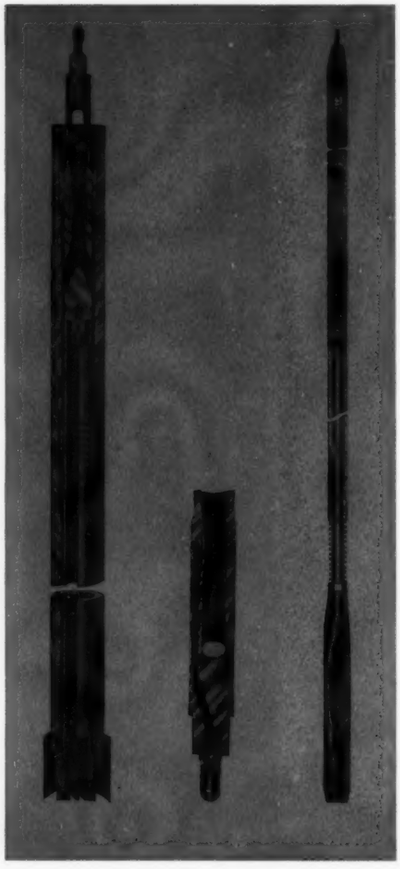
A new electrical instrument that continuously indicates the density of rotary mud while drilling has been developed and is being exhibited by M. O. Johnston Oil Field Service Corp.

The instrument, known as the Johnston mud weight indicator operates on an electrical principle whereby a small power coil electrically operated induces vibration in a unit consisting of an out-put coil, a reed, a reed mount and a paddle. Immersions of this vibrating paddle in rotary drilling mud causes its vibration to be damped by virtue of the resistance to its movement caused by inertia of the mud, which is a function of the mud weight. This damping of the paddle and subsequent damping of the reed mount attached immediately thereto, causes the reed to vibrate at a given amplitude and move the above mentioned out-put coil attached to its end through a permanent magnetic field. This movement causes voltage to be induced in the coil and current to flow through an indicating meter to which it is electrically connected. Varying degrees of dampening, as afforded by muds of different density, causes a subsequent change in the amplitude of the reed and consequently electrical currents of varying magnitude, depending on the mud weight, are produced. Calibration of the electrical meter to indicate these varying currents in terms of density or pounds per cubic foot enables the operator to read directly the weight of the mud in which the paddle is submerged on this scale.


40" DRUM FLANGES 24" CORE LENGTH
1/2" P DRIVE CHAIN
AUTOMATIC CATHEAD
ROTARY DRIVE SPROCKET 2-1/2 P OF 105t
7" DRUM SHAFT - SAE 4140 HEAT TREATED SPLINED FOR DOUBLE BLOCK CLUTCH SEE SPHERICAL ROLLER BEARINGS - SHAFT DRILLED FOR WATER COOLED BRAKES
INTERMEDIATE ROTARY CHAIN
10" H BEAM SKIDDED TYPE FRAME
ROTARY DRIVE FRICTION CLUTCH - DOUBLE PLATE TYPE MOUNTED ON TRANSMISSION OUTPUT SHAFT
MASTER FRICTION CLUTCH MOUNTED ON TRANSMISSION INPUT SHAFT
10" WIDE 5'6" DIA WATER COOLED - EQUALIZED BRAKES
ROLLING POST
4-1/2" DIA ALLOY LINE SHAFT
SKF SPHERICAL ROLLER BEARING
PLAIN CATHEAD POLISHED - HARDENED
1" TRIPLE DRUM DRIVE CHAIN
500 H.P. TRANSMISSION 4 SPEEDS FWD. 1-REVERSE
TRANSMISSION CHAIN 3 - DRIVES - HIGH SPEED ROLLER TYPE
REVERSE COMPACTION GEAR DRIVE
TRANSMISSION SPROCKETS ALL FLOATING ON WHITT BEARINGS BOTH SHAFTS RIDE SKF BEARINGS SHAFT SPLINED FOR CLUTCH BLOCKS
CAST STEEL CASE OIL TIGHT
2 TRANSMISSION BLOCK CLUTCH SHIFTING SHAFTS
TRANSMISSION DRIVING SPROCKET - CHAIN DIRECT FROM COMPOUND
SKIDS EXTENDED FOR MOUNTING MOTOR UNITS



The Byron Jackson stuffingboxless pump, illustrated just above is designed for easy application to all services requiring the pumping of highly volatile liquids such as gasoline, butane, propane, and similar liquids at temperatures not exceeding 150 deg. F. This pump is especially recommended for installation in isolated or hazardous locations, as its construction requires no adjustments, attendance, or shelter, and eliminates the possibility of vandalism.



The stuffingboxless pump has wide range of head and capacity from 15 GPM upward. High suction and discharge pressures offer no problem as the unit is completely sealed in a heavy steel barrel with the pumped liquid isolated from the atmosphere. The pump, and motor of vertical design, are inserted in a heavy, cylindrical barrel and suspended from the flanged barrel cover. The pumped liquid enters the barrel through a suction nozzle at the upper end and passes downward to the strainer between the pump and motor, from which point it is pumped upward through the pumping element to the discharge nozzle in the flanged cover plate. The pumped liquid floats on a pre-determined quantity of isolating liquid, usually water, which separates it from the oil in the motor. A mercury seal prevents the pumped liquid from entering the motor around the shaft, and a balance tube equalizes the pressures on the two sides of the mercury seal. The pumped liquid acts as a cooling agent for the motor.

Following the recent acquisition of the Elliott Core Drill Company by Byron Jackson Co., many improvements have been made in the design of the wire line core drill, illustrated at the top center of this page. This core drill includes an outer barrel with 2-way, 3-way and 4-way bit; all of the pilot type and hard-faced with Tungsten Carbide. Hard-faced, roller-type bits are furnished for shales and hard rock formations.

Also a retractable inner barrel, the core taking assembly which rests freely on the drill collar assembly and is held in position by pump pressure only. The core drill takes full length (10 to 12 ft.) uncontaminated cores with high percentage recoveries due largely to the operation of a patented inner barrel valve. This venturi type valve performs two functions: (1) pump pressure on top of the valve holds the inner barrel assembly on a shoulder in the bit. (2) The high velocity section of the valve is constructed to exert a suction at the upper end of the core-taking barrel which bleeds off mud and cuttings and assists the easy entry of cores from loose and unconsolidated formations.

A new split type casing spider with a rated capacity of 300 tons recently has been developed by Byron Jackson Co. Although, not illustrated here, it is being exhibited at Tulsa. This casing spider is made of alloy steel completely heat treated, and is the split type with a strong hinge pin joining the two halves of the body in the rear. In the front, on one half of the body, is a massive stirrup-type latch similar to an elevator latch which fits over large lugs on the other half of the body, and is double-locked in the closed position by a latch lock.

The casing is supported in the spider by four slips, each slip being 18 in. in length. The teeth of these slips are designed and cut to grip the pipe uniformly without crushing or bottle-necking the casing even under the heaviest casing loads. All four slips are so balanced in normal operation that they automatically move into gripping position, and set positive and uniformly with a minimum of vertical travel even when the pipe is over- or under-size.

Operation of the BJ Casing Spider is accomplished by moving a single lever which opens all four of the slips simultaneously. When running casing, one of the crew holds

the lever in a lowered position so that the slips are retracted and not engaged on the pipe. In the event a falling object, or similar accident necessitates the crew hurriedly leaving the derrick floor, the slips set instantly when the operator releases the lever.

When the slips are in engaged position, a lug on the end of the operating lever drops into a slot in the latch, thus providing an additional lock and making it impossible to open the latch while the slips are supporting the casing. Another safety feature is the fact that the slips must be in the retracted or non-gripping position before the latch can be opened. When the latch is released and the spider is opened a trip holds the slips in non-gripping position.

This spider accommodates all sizes of casing from 5 in. to 13⅜ in. A. P. I. by merely changing the slips which is accomplished by removing the one bolt which holds each slip in place; no other operating mechanism need be disturbed.

Illustrated at the right hand side of the opposite page is a new anti-friction kelly bushing with a shock absorbing, oil resistant rubber cushion, developed by Byron Jackson Co. Side view on top and cross-section below. The body (1) of this kelly bushing is a solid, one-piece steel unit having a corrugated inner bore into which is fitted an oil-resistant rubber cushion (2) with matching corrugations. The backs of the four slips (3) used are correspondingly corrugated and fit directly against the rubber cushion, which absorbs the driving torque. Metal bearing surfaces at the top and bottom of the slips take the radial thrust.

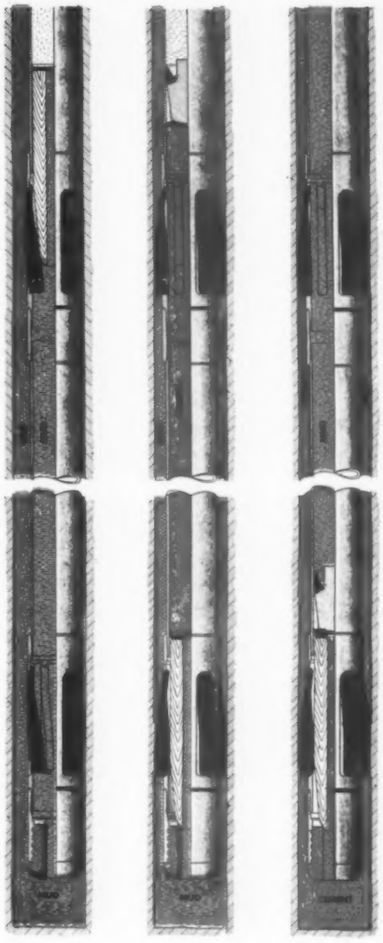
All four slips are faced with liners (4) made of an anti-friction material which takes all wear as the kelly is rotated and moves downward.

Installation of the BJ kelly bushing is accomplished by slipping the bowl over the kelly and sub, inserting the slips and locking them into the bushing with a snap ring and cable. The bushing can be installed on any standard size kelly by using slips of proper size. Because of the renewable feature of the liners, and because torque loads are transmitted through a rubber cushion, it is not necessary to rebuild or to reweld the bushing.

Numerous new products are being presented in the Regan exhibit at the Tulsa show, including a new type of mud screen, a casing centralizer, a heavy capacity swivel and various applications of blowout preventers. The narrow type 121 in. Regan traveling block, with a height of 156 in., various types of tubing heads and tubing blocks will be exhibited and Bettis casing protectors and stabilizers will be shown.

One of the most interesting exhibits of the Regan display is the new Regan casing centralizer, illustrated at the top right hand side of this page. This new device insures a satisfactory cement job by eliminating the occurrence of either insufficient thickness of cement, or no cement at all on one side, due to casing leaning against the formation, It is installed at, or near, the lower end of the casing. The centralizer consists of a steel body member in which six longitudinal slots receive six expandible foot members of drillable alloy metal. The body is designed at its upper end to screw into a casing shoe or collar. When the plug is run through the body, it expands the feet, which then become locked in position exactly centering the casing. This device can be used with regular cementing procedure. It in no way disturbs the side wall cake.

The situation on the left hand side of the illustration referred to above shows two centralizers with foot elements in contracted position being run in a string of casing. Blue area indicates cement and red area mud. In the center diagram, the casing is in the desired position off bottom with the feet expanded to engage the open hole formation. The feet are expanded by the passage of the first cement plug which comes to rest in the shoe. The diagram at the right shows the diaphragm ruptured and the cement being pushed out around the shoe by the passage of the second cement plug.



The Unit Rig and Equipment Company is displaying several models of drilling and servicing units at the International Petroleum Exposition. Models with twin-disc clutches and with their own newly designed Air-O-Matic disc type friction clutches are on exhibition. In addition, there is a double drum service hoist complete with spudder, a single drum servicing unit, and a combination drilling and servicing unit complete with telescoping mast.

The U-10 model is a rotary drilling unit with a capacity of from 2,500 to 6,000 ft., drilling with 4½ in. drill pipe when powered with engines of suitable horsepower.

The unit has an oil bath chain transmission with a system of friction clutches that permit rapid changing of speeds.

The U-10 model with Unit Rig Air-O-Matic disc type clutches, which further reduce adjustments and increase the drilling capacity of the machine, is a recent development. These clutches are of the air type and are not to be confused with air-controlled friction clutches. Air-O-Matic clutches were designed specifically for oil field drilling service and have no adjustments whatever. Provision is made for forced air cooling.

The controls are simple to operate. One lever within easy reach of the driller, controls high, low, and reverse speeds. The driller can, at will, under full load reverse, change from low to high and back to low during any operation of drilling, catheading or hoisting.

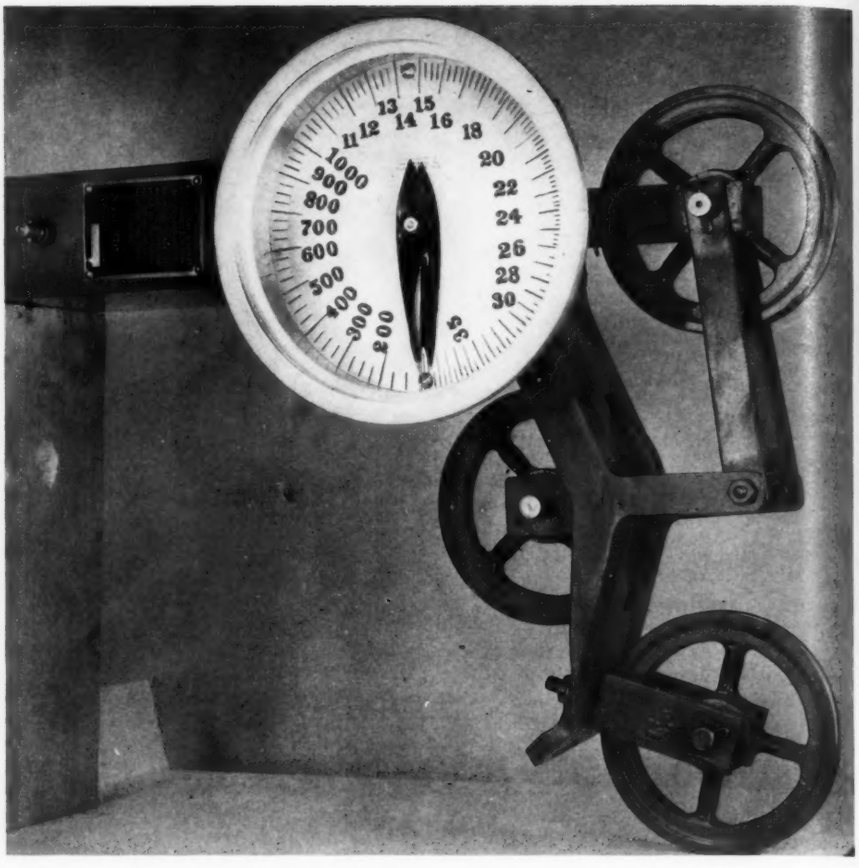
The Unit Rig compound drive system is built for two or three engine hook-ups both for the Model U-10 draw-works and for the reverse clutch hook-ups. As in the U-10's transmission system, the compound including clutches, shifters, bearings, and chain drives is completely housed in an oil tight, heavy plate steel case. It is so made that the assemblies can be easily removed from the case, and for casual inspection of the compound drives, simple lift covers are provided. The compound assembly is arranged to separate from the engines if this is desired and can be reassembled without any adjustments. Through the

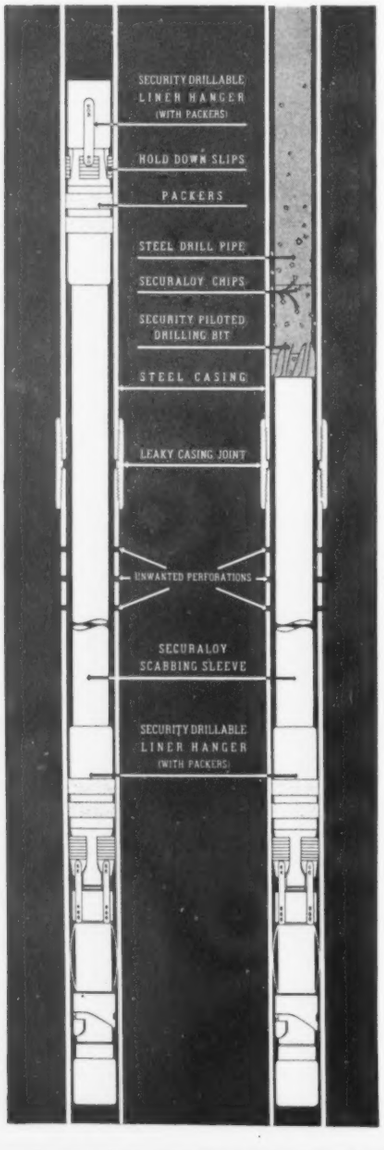
use of this system of clutches one or both engines may be connected to the pump, to the draw-works or compounded. There are a large number of interchangeable parts and all are readily accessible even though tightly housed in the heavy steel case.

The Model U-16 combination rig is a two-drum hoist. The general design and construction permits the use of larger engines and increased drum sizes. Field applications include rotary or cable tool drilling, drilling-in, drilling deeper, pulling or ripping casing, and general well servicing for all depths.

The Model U-17 Service Hoist is essentially a rod and tubing hoist, but can readily be fitted with a rotary attachment for drilling wells down to as much as three thousand feet when adequately powered. A spudder crank can be substituted for the rotary sprocket for fishing, cable tool drilling, and tailing-in. The U-17, when combined with the Unit Rig Model U-19 auxiliary spudder illustrated at the bottom of the preceeding page, will handle all types of work usually done by double drum spudder units.

It consists of a rigid box type skidded frame with a sub-structure, an integral part, on which provision is made for anchoring the single drum hoist, with its power. The free rolling sand line drum is on the same shaft with the spudder cam. There is one sliding double end clutch, controlled by one lever, which engages either the drum or the spudder. A smooth drilling motion is imparted to the drilling line coming off the hoist drum by the spudder assembly, which is rocked by the cam-follower, bearing on the spudder cam. The combined units can be moved like any double drum spudder unit, when trucking facilities are available.





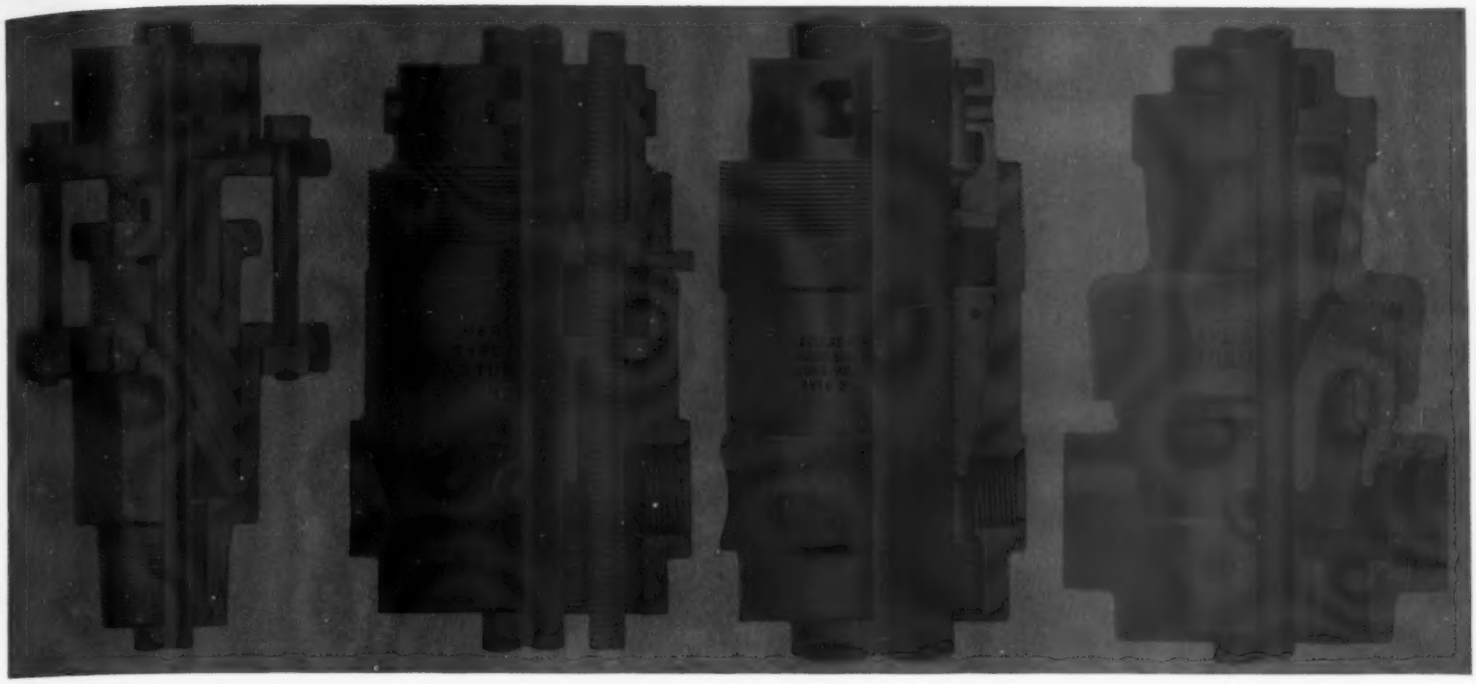
At the Tulsa show, Security Engineering Co., Inc. will illustrate methods for repairing damaged casing or liners, sealing off unwanted perforations, or repairing leaking casing joints, with Drillable Securaloy pipe. The process is called "scabbing". A length of Securaloy pipe with packers of suitable size is inserted into the liner or casing, so that both ends extend beyond the area to be sealed. The complete assembly including the packers and a suitable length of pipe is run in the hole as a unit to a point where the top packing element lies above, and the bottom packing element lies below, the section of casing or liner to be repaired. The pipe is set in place with a Securaloy slip type scabbing packer located at the bottom end and a Securaloy delayed-action adapter with Neoprene packing and hold down slips, at the top end. The slips on the lower packer prevent the assembly from moving downward while those on the top packer prevent upward movement once they are set.

The Security left-hand releasing tool, in combination with the Security delayed-action packer setting tool, is used to install the device in position, to set the packing elements, and to release the run-in pipe from the assembly after the packers are set. This scabbing method of sealing off openings in the casing or liner, effectively blanks off the portion on which repairs are made, yet the entire assembly can be removed from the well with a drilling bit whenever desired.

The Security drillable scabbing assembly illustrated at the bottom left hand side of this page is easy to set, requiring only one trip into the hole to lock the complete assembly into position with permanent fluid-tight seals top and bottom. If it is desired to cement between the sleeve and casing to provide an additional fluid seal, the cementing can be easily done at the same time the assembly is put into place, by using suitable cementing equipment. Normally, this equipment consists of a cementing collar equipped with a back pressure valve, baffle plate, and discharge ports. The illustration shows the scabbing assembly in position on the left and being removed with drilling bit on right.

Line scales illustrated above are made in eight models in order to meet all conditions of rotary drilling requirements and are being demonstrated at Tulsa. Capacities range from 40,000 lbs. to 500,000 lbs. Useful for core drilling, with geophysical equipment, etc. Line scales have been built guaranteed to read within one percent of accuracy around the dial. The line scale illustrated has a capacity of 9,000 lbs. and was designed for well survey with electrical boring equipment.

Across the top of the opposite page are illustrated four tools that are being featured by Hercules Tool Co. at the Oil Show. Reading from left to right, they are: Polish rod stuffing box; cast steel tubing head; casing head; and, stripper tubing head. The polish rod stuffing box consists mainly of a body, an inner gland (upper), an outer gland (lower), and the



packing, which is made up of four cone-shaped rings moulded from fabric and rubber. In the top of the inner gland is a wiper ring of special fabrication which is held in place by a wiper gland. Two high tension cone-point set screws pass through the inner gland and into the wiper gland to hold it securely. The wiper gland is equipped with two extensions or ears by which it may be conveniently lifted. Each gland works independently of the other and each is adjusted on the packing by two high tension hex head bolts with square nuts.

The box is capable of withstanding a hydrostatic pressure of 2,000 lbs. and the tensile strength of the bolts is of the order of 60,000 lbs. per square inch.

The cast steel tubing head illustrated (second from left) is designed especially to be used with an electrically driven bottom-hole pump. The electric cable leading to the pump passes through holes in the packing rings and slips within the head—without interfering with either the slips supporting the tubing or the method of packing off around the cable and tubing. The "Overhead-Packing" arrangement above the slips permits repacking and adjustment of pressure on the packing without lifting the tubing or disturbing the well connections.

Bodies are made of forged steel or electric cast steel, depending on the type of tubing or casing head wanted. The larger sizes have two 3 in. side outlets and a ½ in. opening between the side outlets for attaching a pressure gauge. The larger sizes are also provided with a standard A.P.I. thread on the outside at top of the body for attaching blow-out preventers or other devices while running or pulling tubing. The bodies of the 6⅝ in. and 7 in. size heads are made of forged steel and have oil-saver tops to accommodate wire line oil savers, tubing spiders, etc. These smaller size bodies are equipped with only one 2 in. side outlet but can be furnished with two if desired. A half-inch opening is provided opposite the side outlet for pressure gauge.

The Hercules forged steel casing head (third from the left, in the illustration above) is available in all sizes and is designed to provide an effective means of packing off between two strings of casing. For casing reduction a smaller head is made up on the inside string of casing, independent of the other heads. The inside diameter of the female thread casing head is of the same size as the string of casing on which it is made up. Split steel and rubber packing rings are used above the slips to pack off between the inside string and the casing head, or the two strings of casing. The slips are constructed in such a way that they can be placed together around the inside string of casing and dropped down into the casing head evenly. Slips are provided with slots for attaching wire or rope handles.

Each casing head is made with two 3 in. side-outlets

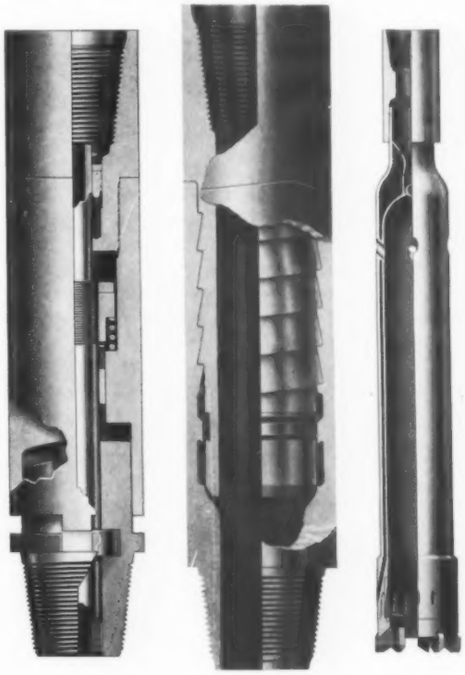
The Hercules stripper tubing head illustrated on the extreme right above has regular 8⅞ in. O.D. casing thread on outside of body at top and supports any standard make spider. It has been tested for 2,000 lbs. pressure and is 18 in. high. It accommodates 2 in., 2½ in., or 3 in. plain or external upset end tubing.

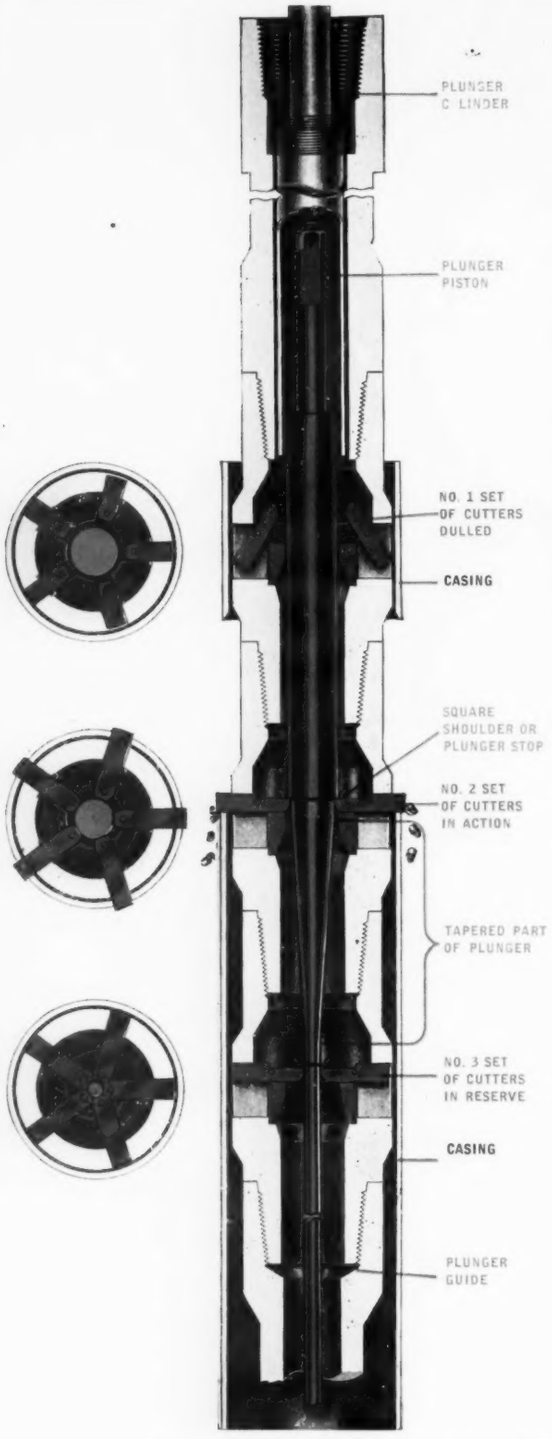
S. R. Bowen Company has developed a new and improved safety joint for use in the drilling or fishing string. This joint, illustrated at the bottom of this page on the right, is of simple construction insuring that the string can be disconnected quickly at the joint, and that it can be reengaged at will. The tool has only two steel parts—a pin and a box section —equipped with high pressure packer rubbers which seal off fluid inside and outside the string under any pressure. Outside diameters and fluid passages on all joints are the same as tool joints of corresponding sizes, thus permitting wire line instruments, to be run through the drill pipe.

The Bowen box spear provides a means of recovering drill pipe stuck in the hole when tool joint box or coupling is up. In operation, the tool is run in the hole on a string of left-hand drill pipe and made up on the box or coupling by right hand rotation. Circulation through the fish can be maintained by means of the fluid passage provided in the tool.

After the slip threads on the tap have engaged the fish, raising the run-in string release the dogs which hold the tool in closed position. Turning the string to the left then causes the cam to offset the halves of the slips, binding the pin in the box and making the joint back-off proof. Since this joint will not unscrew until released, the fish must necessarily back-off somewhere below it. This tool is also illustrated in the center at the bottom of this page.

A new type junk basket for recovering small steel objects lost in the hole, introduced by S. R. Bowen Company, is illustrated at the bottom of this page on the right. The tool incorporates a unique principle of fluid circulation which provides inward fluid flow for washing the fish into, rather than away from, the center of the basket body and permits full pump pressure to be applied.





A new technique in milling out casing centers about a tool that completely mills up in shavings, an entire section of casing well including couplings, and pumps the cuttings out of the hole with the mud. This tool which is illustrated at the top left hand side of this page may be utilized for nitro-glycerine sand or lime shooting, acidizing, setting screen against open sand section in lieu of setting in perforated casing, gravel packing and cement squeezing; for side-tracking through casing by removing casing wall first and then setting whipstock. The tool was developed and is exhibited by the A-1 Bit and Tool Company.

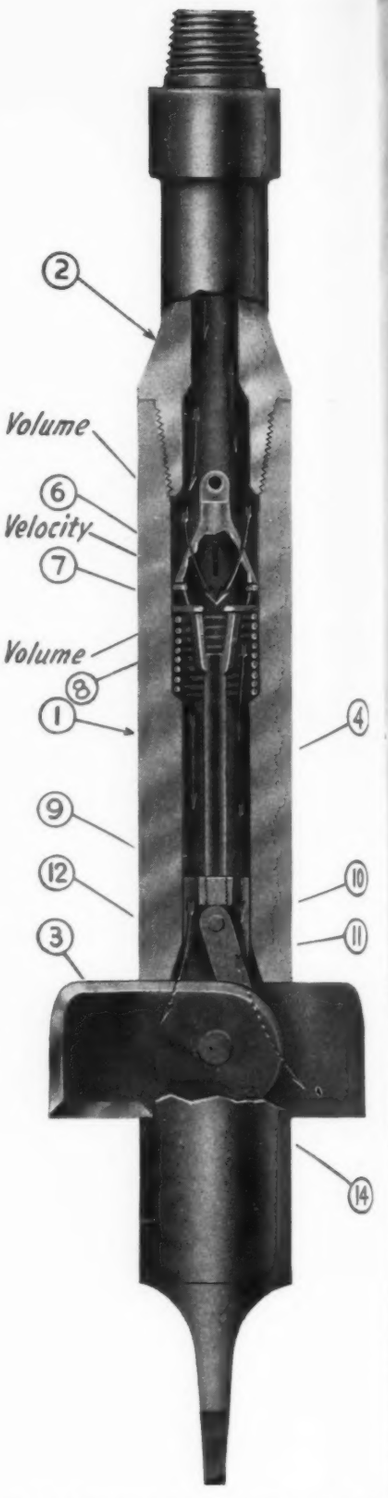
The first operation of cutting through the casing at the desired depth is done by forcing a piston plunger mandrel downward through a cylinder by pump pressure. This downward movement of the plunger mandrel piston forces the cutter knives outward and upward against the casing wall. Rotation of the tool causes these knives to cut through the casing wall and when the knives reach the horizontal plane, the bottom part of the knives become the cutting edges and weight takes the place of the hydrostatic pressure, which has been relieved through the uncovered ports. This cutting-through mill is pulled out of hole when knives are dull, then the self-changing cutter mill is run in the hole with as many sets of knives in series as is desired.

The mill has a long tapered plunger which extends through several series of cutters as illustrated. Pump pressure forces this plunger down through the sets of cutters until the shoulder or plunger stop rests on the first set of cutters, which have been pushed out into cutting position by the downward movement of the tapered plunger. The cutters are expanded in the window where the cutting-through mill has cut away the casing wall. Weight is applied to the first set of cutters and when they are dulled the drill pipe is raised until the dull knives come in contact with the top of the casing window, then a pin is sheared, the cutters fold back and the tapered plunger drops down through No. 2 set of cutters which are expanded by this action. When this set of cutters is dulled No. 3 set of cutters is placed in cutting position in the same manner as No. 2 and so on.

Illustrated on the right hand side of this page is the Grant hydraulic expansion wall scraper, which is being featured at the Grant exhibit in Tulsa among a number of other tools developed by this company. Numbers on the accompanying illustration refer to parts as follows: (1) Body; (2) Sub; (3) Cutter blades; (4)Plunger rod; (5)Circulation control head; (7) Packing ring; (8) Plunger spring; (9) Plunger link head; (10) Plunger link pin; (11) Connecting link; (12) Connecting link washer; (13) Cutter blade spacing washer; (14) Hinge pin; and, (15) Hinge pin key. In operation the abrasive action of the drilling column of fluid is met by a sand control head vented with large slots for big pumps and small slots for small pumps, and in the bell of this control head the vented streams impinge upon each other to dissipate their own destructive force. The fluid travels at high velocity for only $\frac{3}{8}$ in. The tool was designed to remove encrusted rotary mud and projections and irregularities in the hole. It has an expansion range from 4 in. to 40 in.

Axelson Manufacturing Co. has developed a number of improved tools a few of which are illustrated on the opposite page. On the top left hand side is the Axelson anchor hold-down shoe assembly with renewable seat and lock spacer.

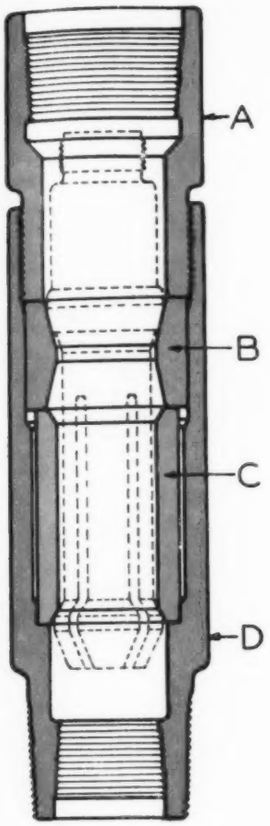
To avoid the possibility of a pump anchor becoming stuck in the shoe due to corrosion, this unit has been developed. The seat and locking spacer are made of stainless steel, hardened and ground, each of which is reversible. Proper assembly is assured at all times,



as the shoe has a stepped bore, making it impossible to assemble the parts in incorrect relation to each other.

The outside diameter of the assembly does not exceed the diameter of a tubing coupling of the size tubing on which the unit is run.

The upper end is provided with a clamping collar (A) with box thread, either plain or upset. This eliminates one tubing coupling. The lower end has male tubing thread, likewise plain or upset, with an inner thread of smaller size to receive the anchor pipe. B is the seat, C the spacer, and D the shoe.



The Axelson top-lock hold-down illustrated at the bottom left hand side of this page allows a stationary type rod pump to be completely suspended from its upper end. This obviates the possibility of sand packing between the pump and tubing, and facilitates removal of the pump, while providing positive anchorage by means of the heat treated spring-prong lock.

The red portion of the diagram shows renewable seating elements and the blue area shows the part incorporating the adjustable rod guide feature.

On the top right hand side the Axelson float-control gas anchor is illustrated in blue print form. As implied by its name this tool has as its principal feature a float tube so arranged that when a well pumps off, the float becomes empty in proportion to the lack of fluid present, and rises in direct ratio thereto.

A tapered plug is assembled to the float tube automatically beaning down the mosquito bill through which the fluid enters the pump, thereby stabilizing production. Gas is separated from fluid by a special mesh Monel wire screen affording large screen areas readily passing fluid into the anchor chamber, but rejecting gas into the annular space between tubing and casing.

Heading and intermittent pumping are eliminated as the float controls the amount of fluid made available to the pump, and fluid therefore is constantly and uniformly produced on each stroke.

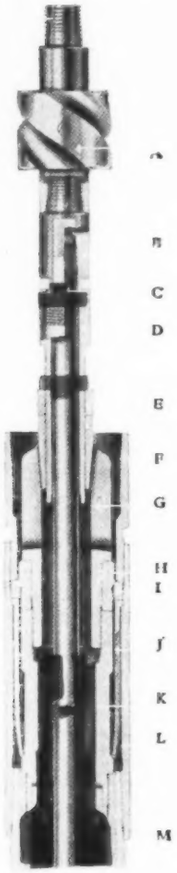
The Axelson casing pump and packer assembly is a new two-unit arrangement that uses standard Axelson pumps employing the metal-to-metal seal. This tool is illustrated at lower right. Tubing pumps, rod pumps, and the new Axelson Sure-Seal pumps are available for this service.

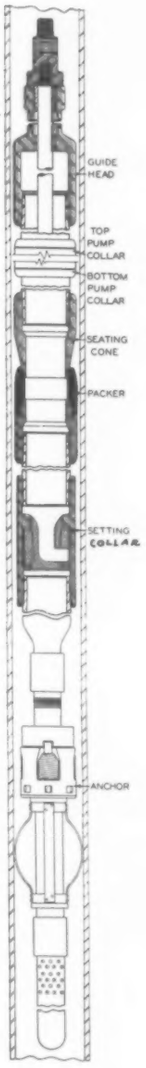
When first being put into service, the lower unit, which comprises the anchoring device and the packer, is run into the well and set by means of the rod string. For this purpose a setting tool is used in conjunction with the cast steel setting collar that is incorporated in the lower unit. The depth at which the unit is set is easily controlled, and operation is essentially the same as setting a tubing anchor.

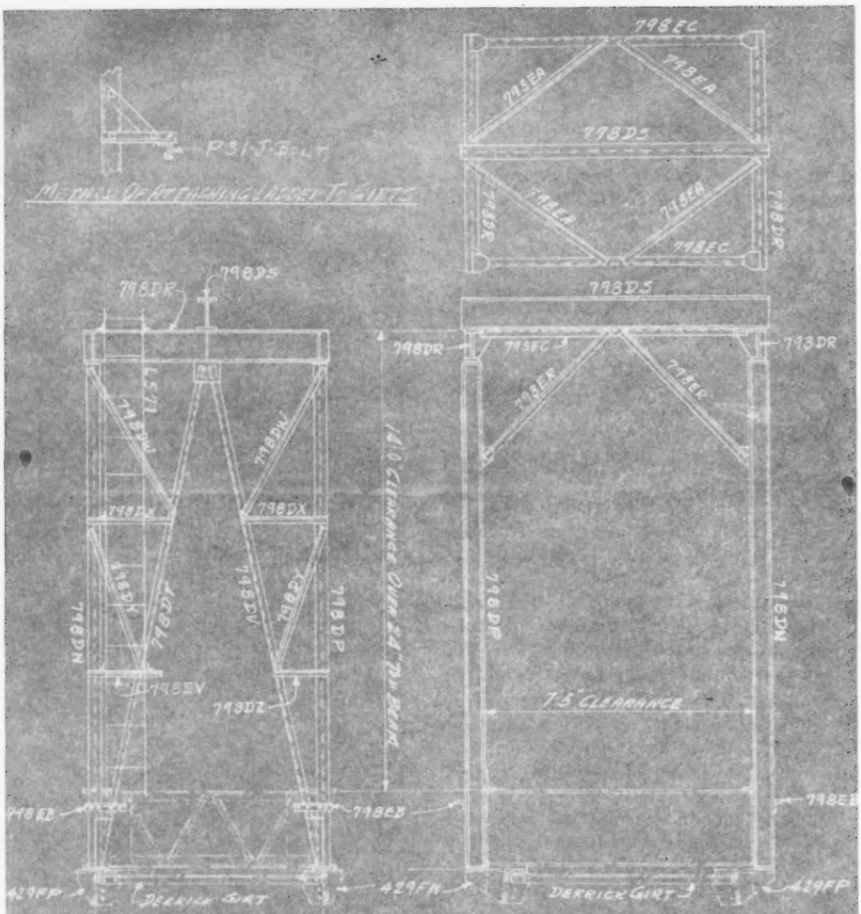
After the packer has been located, the rods are withdrawn, the setting tool is removed, and the pump is then run in on the rods. Seating is obtained by forcing the tapered seating cone on the bottom of the pump into the neoprene packer. This operation serves to expand the packer cup into contact with the casing, thus packing off the casing and seating the pump at the same time.

When it becomes necessary to pull the pump for any reason, it is not necessary to disturb the packer or the anchor as the lower unit remains in the well. Should it be desired, however, to change the location of the packer to some other point in the casing, it is only necessary to run in the setting tool, release the anchor, and move the packer to the new position.

The illustration shows an assembly in which the seating cone is just entering the packer. Further downward movement will expand the packer against the casing and form the seal.

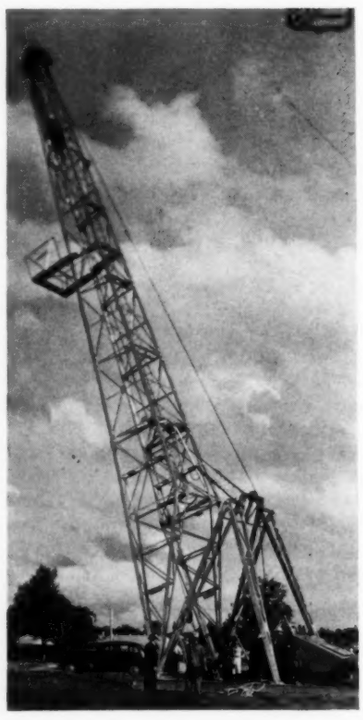


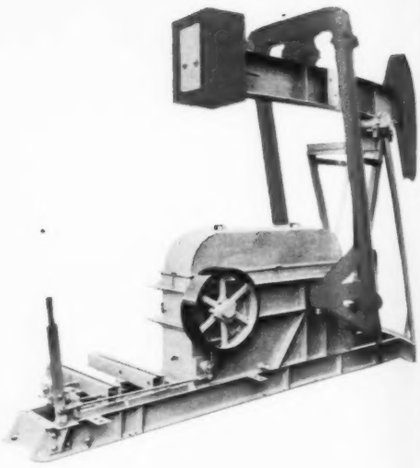


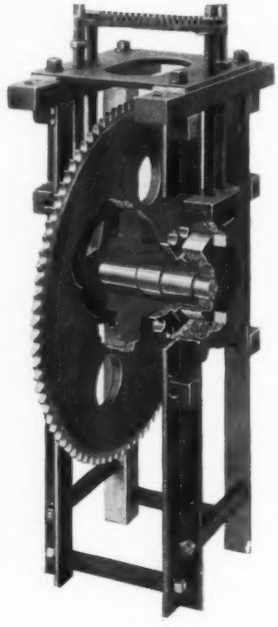


The Lee C. Moore box type gin pole, illustrated in blue print form at the top of this page is furnished on heavy drilling derricks 122 ft. high and over. It is being exhibited at the Oil Exposition. The gin pole was designed to overcome failures due to dragging heavy loads from outside the derrick up on to the derrick floor with the derrick line before the crown block has been erected. The four wide flange beam corner columns are well braced to take the horizontal loads imposed, and the lifting capacity is such that the heaviest crown blocks may be raised with a single line. Sections of large crown blocks can be suspended by slings from the horizontal beam of the gin pole, while the remaining sections are being raised and placed. This gin pole has a vertical lifting capacity of 10,000 lbs. over a single pulley, 1,200 lbs. horizontal at right angles to the cross beam and 900 lbs. horizontal parallel to the cross beam.

The Moore Redhead pumping unit illustrated at the top of this page is constructed on an all-steel welded frame with integral welded chain reduction case. All three of these heavier units have needle bearing mounted saddles and stirrup bearings. Main and countershafts are mounted on roller bearings and the twin sprocket on the intermediate shaft is free-floating on needle bearings. All chains are bathed in oil and the bearings are lubricated from an oil reservoir. The units have twin equalizing pitmans and the wrist pin bearings are oil sealed for either oil or grease lubrication. All of these units may be fully crank counterbalanced, or a combination of beam and crank counterbalance may be used. Each unit includes the patented chain adjuster illustrated just below the pumping unit. Both chains of the reduction unit may be adjusted by the turning of a single screw. By this adjustment the tension on both chains is equalized by the rotation of an eccentric about an established axis. After the chain has been adjusted, the intermediate shaft is locked by two clamping screws.

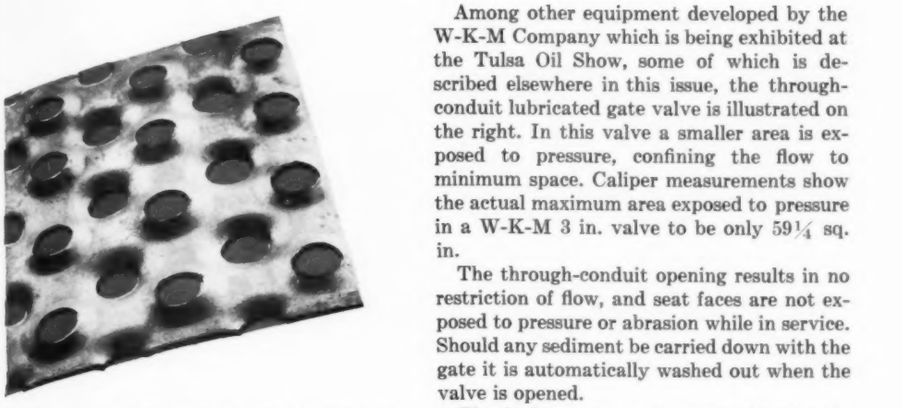






At the bottom of this page is illustrated the Lee C. Moore Jacknife Cantilever Mast which will be featured at the oil show. The derrick is constructed in five individual units, assembled horizontally on the ground and raised to a vertical position as a unit. The derrick has a height of 87 ft. and is suitable for regular, shallow or slim hole drilling. The top section, some 26 ft. in length carries the crown block and is 2½ by 3½ ft. at the top. Sheaves are 36 in. and 30 in. on roller bearings. There is also an 18 in. deadline sheave. The mid section is 29 ft. in length while the two bottom sections are 36 ft. in length. The fifth unit is the base, 12 ft. 8 in. by 30 ft. in length.

In drilling operations no guy lines are used. Capacity is 300,000 lbs. based on A. P. I. rating. The drilling line is taken over a sheave at the top of the gin pole, thence through the crown block and travelling block. The line is strung for drilling but secured at one end to the base of the derrick; a sling line is connected to the drilling hook and the top of the gin pole and the derrick is jacknifed into an upright position.



Just above is illustrated two views of Lee C. Moore's newly developed non-skid grating; the upper view shows a cross section, the lower illustrates the surface. This grating is made rigid by punching holes with bosses from both sides of the plate. The process increases the section through the plate and adds to its bending strength. Holes punched upward through the plate provide a non-skid walking surface, and the holes punched down supply the necessary drainage.

This grating may be used for derrick platforms, engine house floors, walkways, cat walks, etc., as well as tank walks, cellar covers, stairs, boat landing, etc.

The Otis wire line paraffin scraper, manufactured by Otis Pressure Control, Inc., is on display for the first time at the International Petroleum Exposition. It is illustrated on the left.

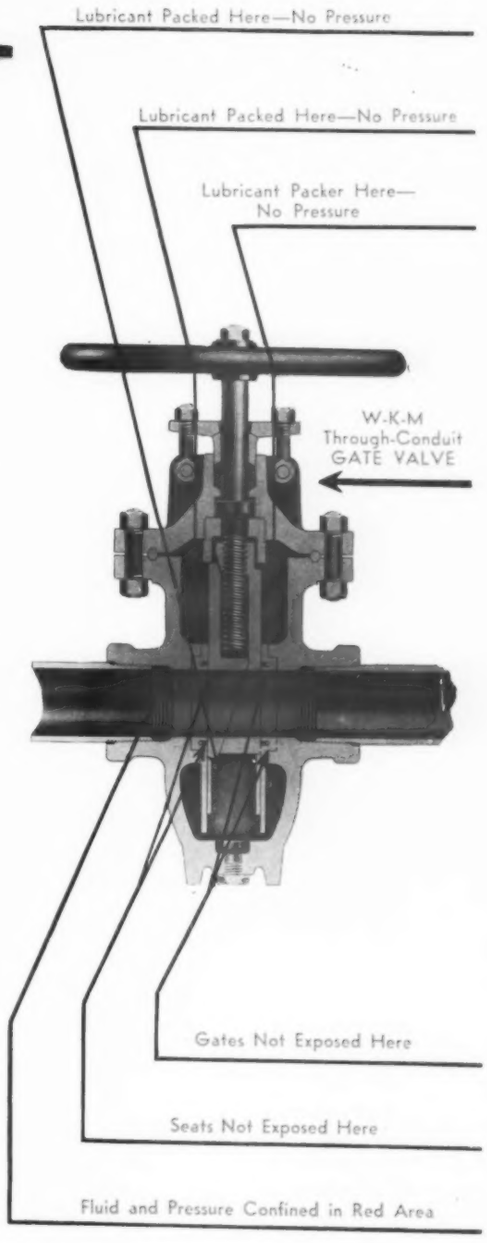
The scraper is run into the tubing of a flowing well under pressure on a steel wire line and utilizes flow energy and velocity in removing paraffin deposits. Possibility of the scraper being blown up the hole while being run against flow is eliminated by a safety lock that has a set of slips which are held in constant engagement with the tubing walls. It will allow the scraper to move downward, but will bite into the tubing and lock the scraper against any upward movement.

The spiral cutter which may be seen in the illustration is tapered to a small diameter at the lower end, so that it may remove paraffin deposits which have almost plugged the tubing. It is balanced on a ball bearing swivel, so that it rotates true and freely without wobble. The spindle of the swivel is stationary while the housing, to which the cutter is attached, rotates. The bearings are completely enclosed so that they cannot be fouled by paraffin.

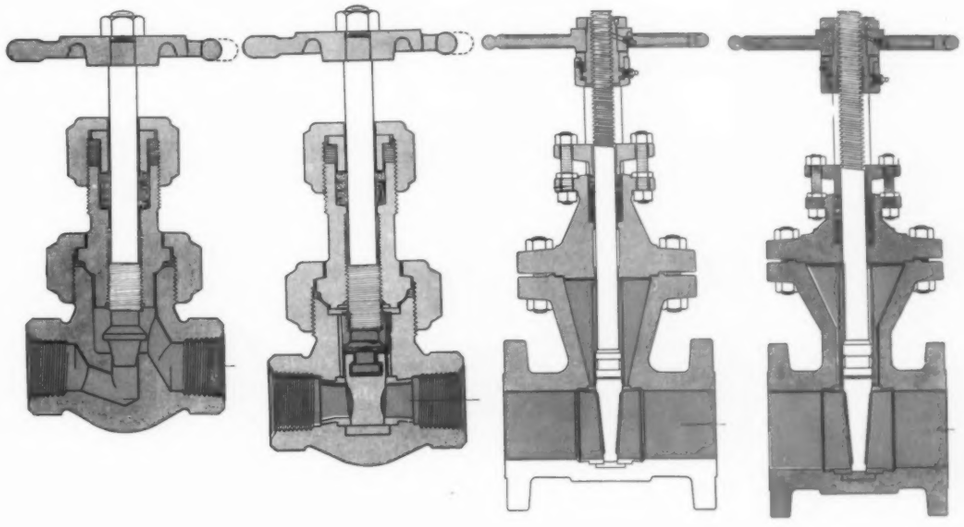
Among other equipment developed by the W-K-M Company which is being exhibited at the Tulsa Oil Show, some of which is described elsewhere in this issue, the through-conduit lubricated gate valve is illustrated on the right. In this valve a smaller area is exposed to pressure, confining the flow to minimum space. Caliper measurements show the actual maximum area exposed to pressure in a W-K-M 3 in. valve to be only 59¼ sq. in.

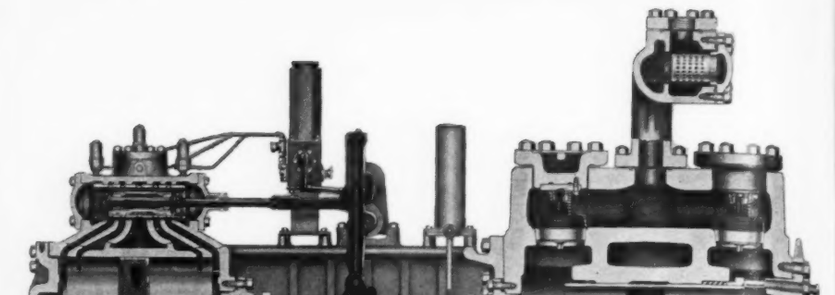
The through-conduit opening results in no restriction of flow, and seat faces are not exposed to pressure or abrasion while in service. Should any sediment be carried down with the gate it is automatically washed out when the valve is opened.

The body serves as a grease chamber, in which all moving parts are entirely submerged in grease (the 3 in. valve holds 6 lbs. of grease).



At the bottom right hand side of this page are sectional diagrams illustrating four valves being featured by Henry Voght Machine Co. at the International Petroleum Exposition. On the left is a drop forged steel globe valve for a working pressure of 900 lbs. at 750 deg. F. designed principally for meter and gage line service. The valve can be repacked under pressure and the one-piece needle point stem may be grounded or replaced. Second from the left is a drop forged steel gate valve, also for 900 lbs. working presssure at 750 deg. F. This valve has a union bonnet, ground joint, inside screw stem, removable seats and slotted gate. It is all stainless steel for corrosive oils. Third from the left in this group is the Vogt drop forged steel flanged gate valve for a pressure of 150 lbs. at 750 deg. F. The flanges are forged as an integral part of the tool and it has a bolted gland, a round bolted bonnet, gasket joint, outside screw and yoke. It is furnished regularly with a 1/16 in. raised face, stainless steel trimmings and slotted gate. The stem thread is not exposed to the service temperature. The valve on the extreme right is the same as the one next to it except that it is suitable for 300 lbs. pressure at 750 deg.





The Miller Sand Pump illustrated at the left, together with various interchangeable bottoms is being featured by Miller at Tulsa. The heavy duty sand pump is shown at the extreme left; on the top of the page is shown the chisel bottom used where sediment is tightly packed and must be broken up before removal; second from the top is the star bottom also used for breaking up tightly packed sediment; third from the top is the bailer bottom used when the sand pump is used as a regular bailer; and on the bottom is the sand bottom for use when sediment is loose and can be picked up easily.

In operation the sand line is run through the bail and babbitted into the sand line socket. The sand line socket can be removed from the eye bolt to allow babbitting to be done a safe distance from the well. When the socket is screwed onto the eye bolt the sand pump is lowered to bottom of well. On reaching the bottom the sand line is slackened, the plunger valve opens, and enough time is allowed for the plunger to sink to the bottom of the tube. The line is then reeled in, and the plunger, traveling to the top of the tube with the plunger valve closed and the bottom valve open, creates a powerful suction filling the tube with sediment. Continued reeling in of the sand line lifts the pump and the weight of the sediment in the tube closes the bottom valve, holding in the sediment while the pump is being pulled out of the well to be emptied. If sediment is packed tightly and spudding is necessary, the heavy-duty Miller is constructed to stand this action.

The Gardner-Denver divided fluid cylinder pump, of which a sectional drawing appears at the top right hand side of this page, comprises one of the principal features of the Gardner-Denver exhibit at Tulsa. This is a 3,000 lbs. fluid pressure pump having a steam cylinder 16¼ in. diameter, a fluid cylinder 8 in. in diameter and a stroke 20 in. long, designed primarily for rotary drilling slush pumps. Normally the pump has a capacity of 327 gallons per minute but can achieve as high as 654 gallons per minute maximum. The steam pipe is 4 in., the exhaust is also 4 in., the suction is 10 in. and the discharge is 4 in. The pump is 12 ft. 2 in. long, 6 ft. 3 in. wide, and 6 ft. 2 in. high and weighs 22,500 lbs. The fluid end consists of two entirely separate cylinder castings, which are united by the combined suction manifold and cylinder foot at the bottom, and the discharge manifold above the cylinders. The cylinders are also rigidly tied together by the flange of the one-piece steam cylinder cradle. All walls are exposed for inspection, and there are no inner baffles or metal sections between the two sides of the fluid end to be cut through by the mud.

Merco Centrifugal Co. has developed a new tool which is being announced and displayed at the Tulsa show. This is the Merco Type A-24 Concentrator which is specifically designed to prevent waste of drilling mud and weighing material. Installed adjacent to the mud ditch, the concentrator takes off a small portion of previously desanded mud (10 to 25 gallons per minute), which may be diluted with 1 to 2 parts of water. The diluted weighted-mud is then centrifuged and the weighting material is concentrated in the underflow and again remerged with the circulating mud stream. The colloids, gas and excess water are decanted in the overflow of the concentrator and go to waste. Under this method, any desired concentration may be attained up to a density of 120 lbs. per cu. ft. It is only necessary to operate the concentrator so long as the weight of the mud from the well is decreasing. Mud weight can be reduced if desired, by diverting the concentrated weighting material to storage.

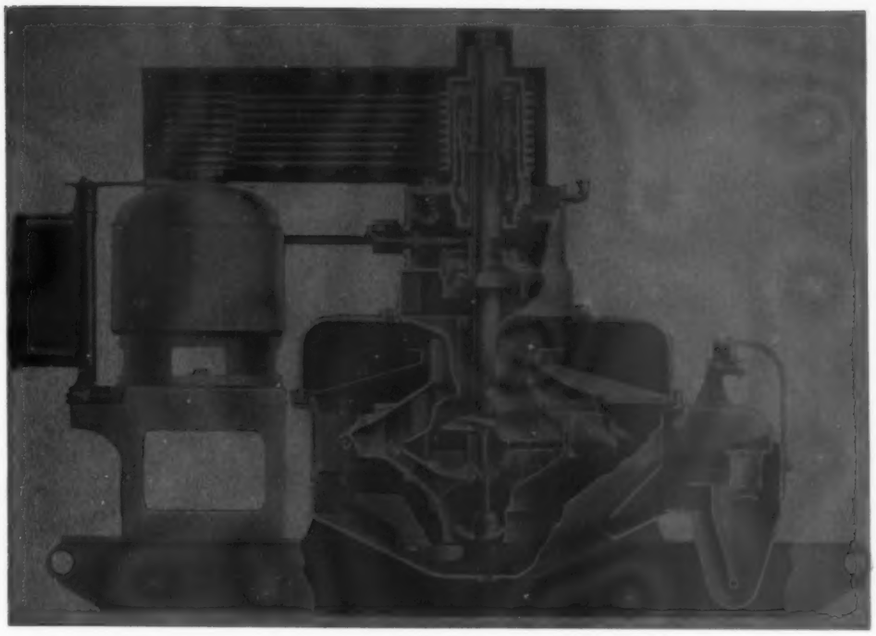
The concentrator has a capacity of 300 gallons per minute, is 7 ft. long, 43 in. wide and 5 ft. high. It is driven by a 40 h.p. motor through a V-belt and weighs with the motor 3,700 lbs. Illustrated at top of facing page.

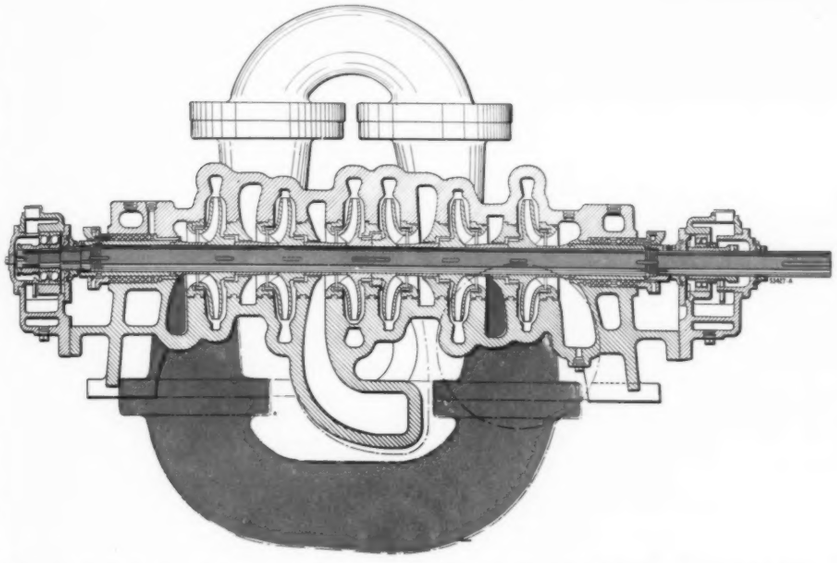
Ingersoll-Rand Company, is exhibiting a number of pumps for oil refineries and pipeline use at the International Petroleum Exposition. They are also showing one of their

latest models of portable compressors for use in construction, pipeline, and repair work; and several small air compressors for starting Diesel and gas engines.

A major feature of the exhibit is illustrated in the center of this page. It is an Ingersoll-Rand class RT pump for pipeline use. These pumps are built to handle capacities from 150 to over 2,000 gals per minute against pressures from 200 to over 1,350 lbs. per sq. in. They are built with the discharge sizes of 2½, 3, 4, 6 and 8 in.

Class RT pumps were designed specifically for pipe-line work. They may be driven by any type of prime mover as the shaft has been designed strong enough for drive by Diesel and gas engines. These pumps are of the single-suction, opposed-impeller design with the horizontally split casing. Half of the impellers have their inlets facing in the opposite direction from the other half. This construction assures longitudinal hydraulic balance and eliminates the need for any type of balancing drum.





The impellers are sealed against leakage by means of renewable, double, wearing rings.

The rotor is supported by large oil-lubricated, ball bearings. One of these bearings is of the duplex, angular-contact type designed to take care of any thrust loads that may be developed. The other is of the double-row, self-aligning type and it is free to move longitudinally in the casing.

Deep stuffing boxes seal the shaft. These stuffing boxes contain a number of rings of packing and can be arranged for grease, water or cold oil lubrication, depending on the liquid to be pumped. The stuffing-box glands are of the two-piece type which can be removed from the shaft.

The Reda electrical centrifugal submergible oil well pump which is on display at the oil exposition is direct connected to a motor through a protector section, the entire assembly being of small diameter so that it can be run in a well. The unit is suspended on tubing with a cable extending from the surface to the unit to carry electricity to the motor. The Reda motor is a two-pole, three phase, squirrel-cage induction type, filled with oil for lubrication and cooling. Field windings are continuous throughout the length of the stator. The rotors, however, are only fifteen inches long with bearings between each to guide the shaft to maintain centering in the field. Motors are made in two outside diameters 4½ in. and 5⅜ in. The motor protector contains a spring-backed piston, a grease chamber, with grease supply sufficient for six months' operation, and an oil chamber. It serves to provide a pressure in the motor in excess of the external pressure due to submergence, and to prohibit contact of well fluid with the oil in the motor. Because of this feature the motor will operate at any depth, or at any distance below the fluid level.

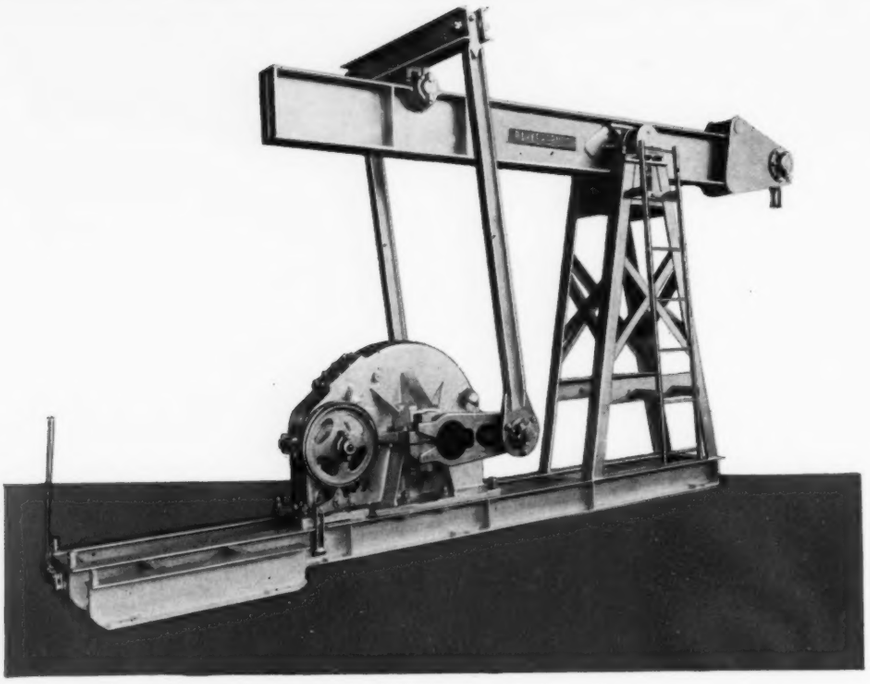
The pump is a vertical assembly of centrifugal impellers and diffusers of the required number, size and diameter to produce the desired volume against the required discharge head. As many as 317 stages have been put into a single pump, the length in this case being about 25 ft.

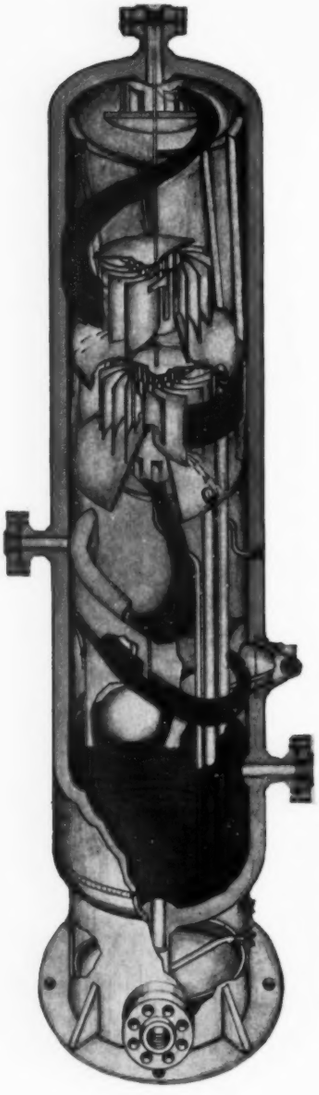
The cable is steel armored and flexible enough to permit easy spooling. In installations it is clamped to the tubing at intervals for support. Various copper sizes are used depending on depth and horsepower to be transmitted. In wells with small diameter casing, a three-conductor flat cable extension is spliced to the end of the round cable to gain greater clearance opposite the unit itself.

Motors are wound for voltages from 325 in the smallest to 850 volts in the largest, and the supply voltage must be enough higher than these values to provide for cable drop. As many sizes of units as possible are arranged to operate directly off the 440 volt line, and when some voltage correction is needed small auto-transformers are provided. Where electric power is not available engine-generator sets can be used to operate one or more units.

Reda pumping units are available with motors from 3½ h.p. to 135 h.p. and pumps to produce any volume up to 15,000 bbl. per day. The casing size imposes the limitation upon maximum production rates as for example 1,900 bbl. per day can be produced if casing is 5½ in. O.D.; 13,000 bbl. per day can be produced if casing is 8⅝ in. O.D.

Since the only apparatus needed at the surface is an electric switch to start and stop the pumping unit, considerable flexibility in manner of operation is possible. Where medium or large rates are being produced the well will ordinarily be allowed to pump continuously. In wells with small productive capacity, or an allowable of less than 100 bbl. daily, the pump will be intermitted. For this latter type of well automatic controls are provided to institute any desired number of pumping operations during the day or night. Another control permits the unit to continue operation as long as it is producing, but stops it when the well pumps off. After a predetermined interval of time allowed for the fluid to accumulate in the hole the pump is automatically restarted. Thus in any sized well the pumper has very little to do but switch tanks.





Illustrated at the top of this page is the Parkersburg 36 BU pumping unit one of the more recent additions to Parkersburg's line of pumping units.

A summary of its specifications are as follows:

Summary of Unit Specifications

Length of stroke—18″, 27″, 36″.
Strokes per minute—up to 30.
Beam load capacity—11,600 lbs. A.P.I.
Maximum effective counterbalance—7,500 lbs.
Type of counterbalance—beam.
Walking beam section—16″ @ 58 lb. CB.
Working centers of walking beam—6′ 0″ each end.
Length of base—15′ 10″.
Width of bases across main sills—22½″.
Height at Samson post—9′ 0″.
Sill clearance with well center—3′ 5½″.
Hanger clearance with floor level at bottom of maximum stroke—6′ 10″.
Clearance for well servicing—21″.

Gear Reducer Specifications

Total weight of reducer—2965.
Horsepower capacity at 20 S. P. M.—18.12.
Peak torque rating at 20 S. P. M.—89,000 in. lbs.
Total ratio—10.25 to 1.
Low speed shaft diameter—4¾″.
High speed shaft diameter—2½″.
High speed shaft bearings—Roller.
Low speed shaft bearings—Bronze.
Maximum diameter driven sheave—32⅞″.
Minimum number and size V-belts—6-C.

On the left is illustrated another unit that is on display at the Parkersburg booth in the Tulsa oil show. This is the Parkersburg-Smith Oil and Gas Separator. Particular attention should be given the manhole on the side of the separator shell for entrance independent of the forged steel float control, placed conveniently to reach float ball. Another feature is the steam chamber in the skirt of the separator, giving greater heat transfer than coils and removing the hazard of leaking steam coils putting separator pressure back on the boilers.

The accompanying sectional sketch illustrates a Parkersburg-Smith high pressure separator with inside float control.

The oil and gas enter the separator at inlet on shell of separator through a specially designed deflector baffle, much greater in area than the incoming line, thereby slowing up slightly the movement of the oil and gas and directing the oil down in a thin sheet or film on the inside shell of the separator, which allows the gas to separate easily.

The gas (blue) travels upward as it leaves the deflector baffle into the full area of the separator, which slows up the movement of the gas and permits gas trapped in the accumulated oil in the bottom of the separator to escape upward to the separating elements. A great deal of separation is secured at this point, between fluid level in separator and the separating element. As the gas travels upward the moisture settles out and accumulates upon the separator shell and the underside of the first centrifugal separating element before reaching the centrifugal baffle entrance to the first element. The gas passing through this element insures further removal of moisture from the gas, and such moisture is carried by a drain to bottom of separator.

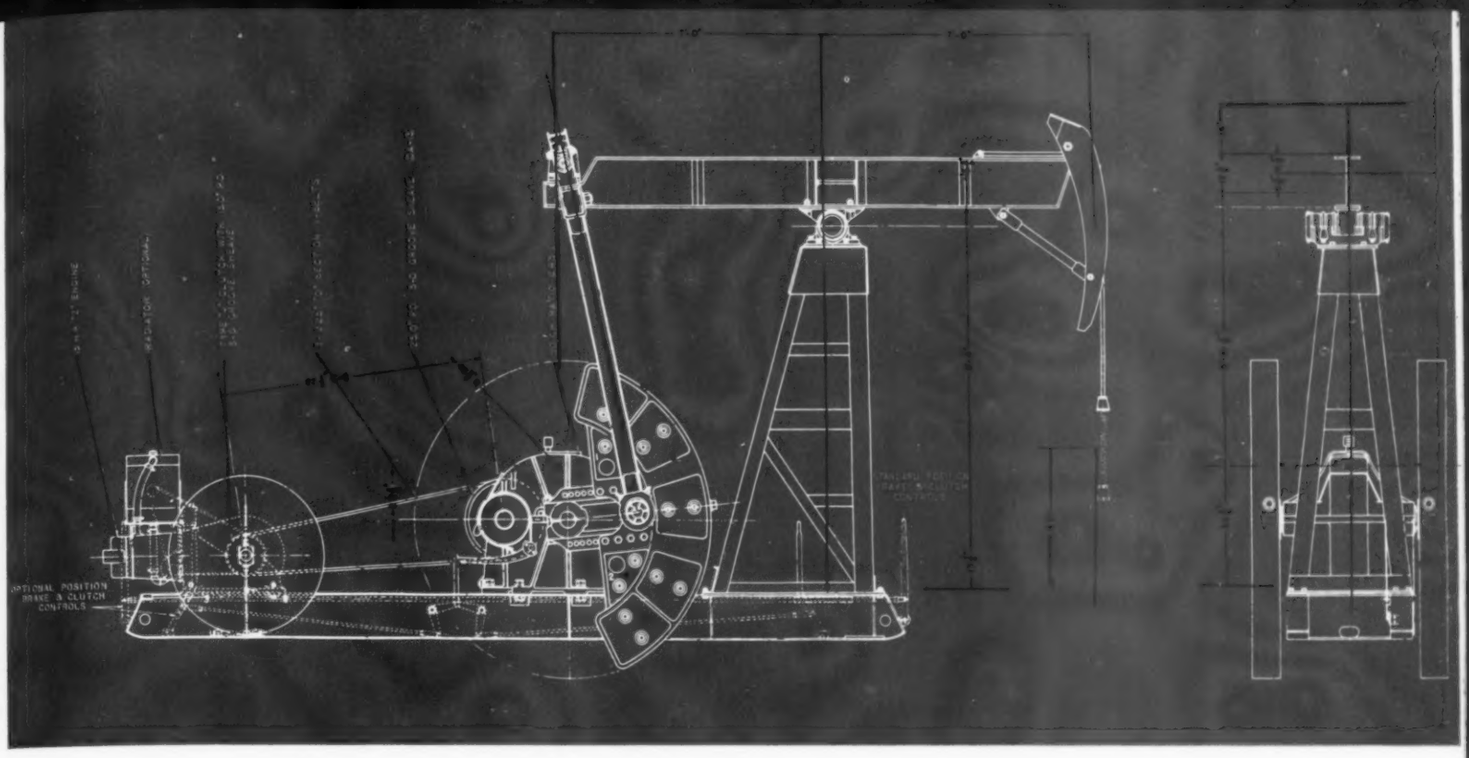
The centrifugal motion of the gas is reversed as it passes into the first major separating element, which is welded tightly to the inside of the separator shell. Due to change in areas, the vane and slot areas not only give centrifugal motion, but produce compression and speeding up as well as expansion and slowing up of the gas. The expansion condenses moisture or suspended oil which inertia (being greater than gas) passes to the surface of the curved vanes, again securing accumulation of oil upon each side of the vanes and under the top cover plate. Fluid removed from the gas at this point is carried by drain to bottom of separator.

The gas proceeds to the second centrifugal separating element, following the same procedure as in the first major element, except the centrifugal motion is reversed and removed fluid is carried below by a drain from the top side of separating element. Then slanting baffles on the inside of the shell with a top spiral ring accumulate moisture which is carried to drain mentioned above. At this point the gas is again slowed in movement due to the full inside area of separator being used. Gas then passes through to gas outlet centrifugal baffle before entering gas discharge line.

Of especial interest at the Continental Supply exhibit in the International Petroleum Exposition will be the complete line of D&B oil well pumps displayed by The Continental Supply Company and Continental-Emsco Company, Inc. The new armored liner used in these pumps has high resistance to wear and abrasion. Made from graphitic steel, these liners have both high physical properties and low coefficient of friction.

The illustrations on the right hand bottom side of the facing page show three insert liner pumps using this new liner. On the left the stationary insert pump with the top lock provides a combination pump and gas anchor. The fluid is discharged immediately above the lock, thereby keeping sand actuated, preventing the pump from sticking.

An inverted insert type pump is shown in the middle of the illustration which is especially recommended for sandy conditions. Its design provides for the sand to be activated



throughout the entire pump length and including the area of the seating device.

An economical installation is provided in the stationary insert pump with 3-cup bottom hold down shown on the right of the illustration. This pump is recommended where sandy conditions do not prevail.

In all cases, these pumps have both their standing valves and traveling valves located close together to prevent gas locking.

The Continental Supply Company and Continental-Emsco Company, Inc., will also display a pumping unit well suited for medium depths and production—a twin crank pumping unit, a part of the Continental-Falk line. The diagram at the top of this page illustrates this model. With horsehead beam hanger, anti-friction beam bearings, sealed oil bath center iron and equalizer bearings, cast steel (not welded) equalizer, four-legged samson post, and unusually wide skids, together with a conveniently located service brake, this unit is designed to provide structural economy without sacrificing operating efficiency.

The Emsco-Slonneger crank counterbalance used on this unit permits stroke adjustment without disturbing the precision of counterbalance. The design of this balance also places the center of weight at the crank pin, thus causing shocks at the well to be delivered at the center of gravity, thereby minimizing the reactions produced on the crank and shaft.

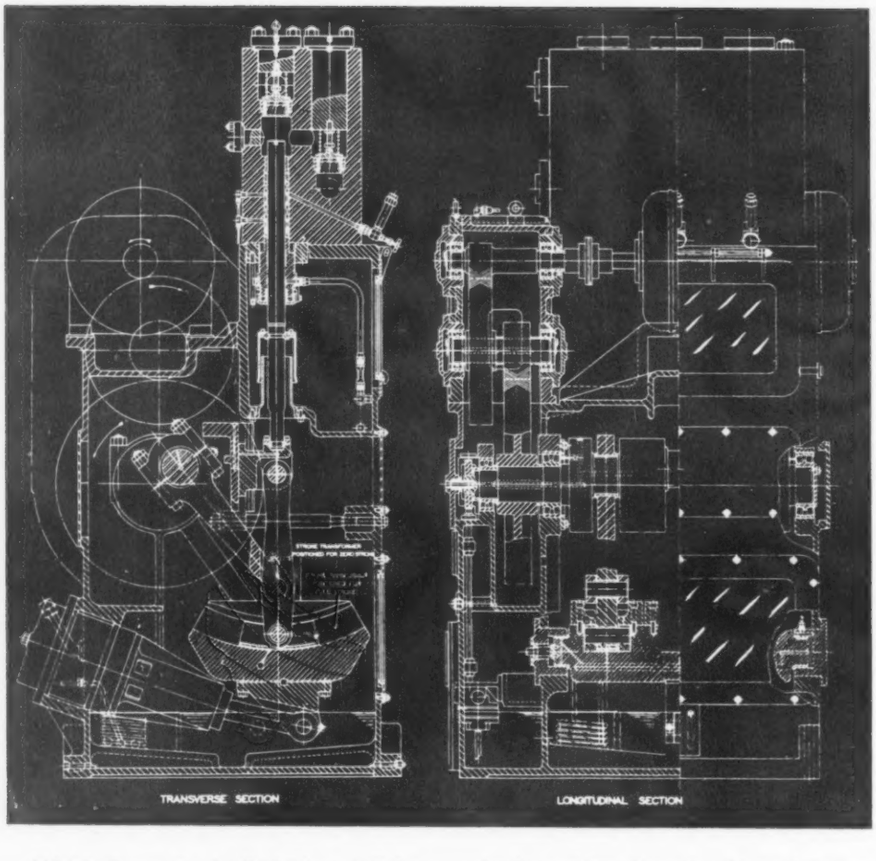
The Falk gear reducer used on this unit utilizes herringbone gears cut on a special machine. The design of the gears is symmetrical and the gears may be reversed after years of service to obtain additional life. A special trough lubrication system provides an ample supply of clean lubricant to all bearings. The high speed bearings are of the SKF self-aligning spherical roller type, while the low speed bearings are bronze backed and babbitt lined, two bearings being placed on each side of the gear. The sturdy case design assures proper rigidity and reduces deflections to a minimum. Dustproof oil retainers and an air vent insure proper protection to moving parts with adequate ventilation.

A second Continental pumping unit, not illustrated is being displayed by The Continental Supply Company and Continental-Emsco Company, Inc. It is designed for use on light wells where a low priced single well unit is required. The unit is completely self-contained. It requires a very simple foundation.

The main base and samson post form a unit, the two members being welded rigidly together, supported by two angle bases. The walking beam has a provision for beam counterbalancing and is equipped with wire line head removable for servicing. Needle roller bearing construction is utilized in the walking beam center bearing.

The double reduction reducer is equipped with herringbone gears and mounted on steel shafts which in turn are mounted on roller bearings. Short bearing centers insure minimum shaft deflection. The reducer case of box type cast iron construction is rigidly designed, has a substantial cover plate with adequate gaskets, and is properly vented.

The gears and pumper reducer bearings are partially submerged in oil insuring positive lubrication. Shaft extensions are provided with oil and dust seals to prevent leakage or enterance of dust into bearings.



Aldrich Pump Co. is displaying at Tulsa the newly developed Aldrich-Groff "Powr-Savr" pump, which is the variable-stroke, vertical, triplex type designed for such applications as liquid process charging, boiler feeding, steam desuperheating, hydraulic press pressure, and similar uses. This pump affords positive control of delivery without requiring any change in motor speed. Almost any free-flowing liquid can be handled at pressures ranging from 200 to 1,500 lb. per sq. in. Control of the delivery rate may be accomplished either manually, or automatically according to the indications of various sorts of instruments, and control may be from a remote point.

The principle of the new pump is indicated in the above cross-sectional drawing. The variable stroke feature represents an important innovation. The three plungers are all driven from the single crankshaft by individual mechanisms, but since all are driven identically the following description will apply to only one.

The pump crank, driven through herringbone reduction gearing from a constant speed motor, causes reciprocation of the connecting rod. This rod is pivoted to a link and serves to oscillate the link above its pivoted connection to the pump plunger crosshead. At the bottom of the link and connected to it by a pivot is a guide block which slides back and forth in a smooth curved track in the "stroke transformer." The radius of curvature of this track corresponds to the length between pivot centers of the link.

In the position shown for the stroke transformer, oscillation of the link causes no movement of the piston. However, when the piston in the adjustment cylinder, through its connecting link, tilts the stroke transformer upward toward the right, the effect is to produce reciprocating movement of the plunger upon oscillation of the link. Since the stroke transformer can be tipped through any angle from zero to a maximum, movement of the pump plunger can be controlled between zero and the maximum capacity of the pump.

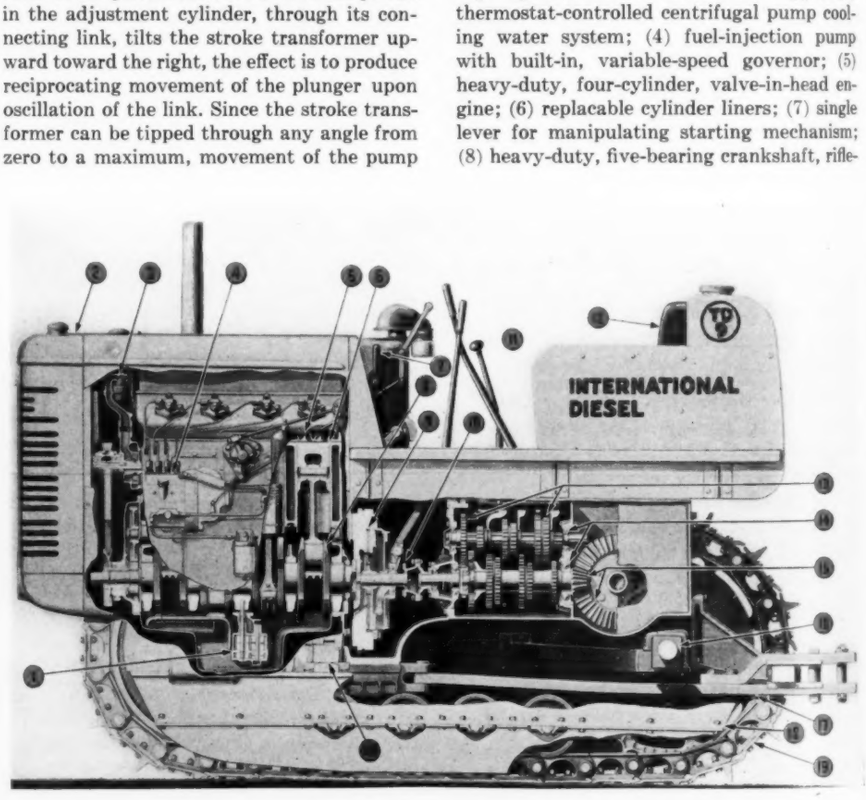
The unit illustrated is a 2½ in. by 6 in. stroke unit with a capacity of 40 gallons per minute at a crankshaft speed of 115 r. p. m. against a maximum discharge pressure of 1,400 lbs. with liquid flowing to the pump under 150 lbs. pressure. The unit is operated by a 40 h.p. motor.

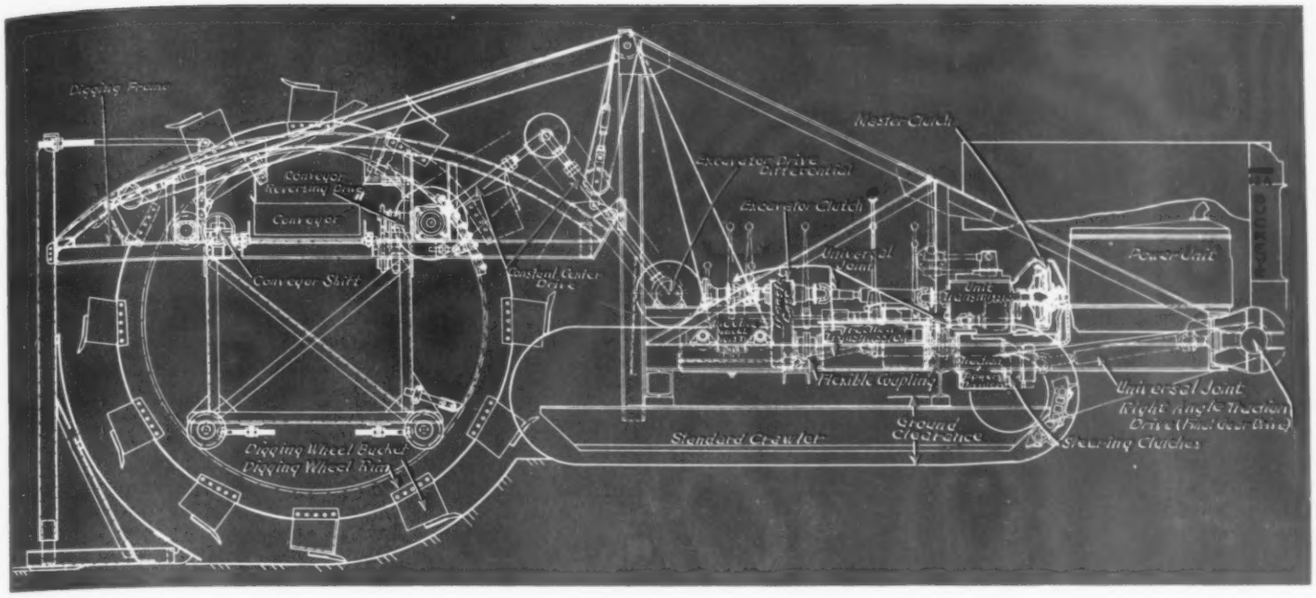
The International Harvester Company will again show at the International Petroleum Exposition in Tulsa, a wide variety of motor trucks, tractors and power units especially equipped and adapted for oilfield work.

Included in the display of International tractors will be four sizes of recently announced Diesel TracTractors, one of which is illustrated in cross section below. Ten power units will be shown—four Diesel sizes and six models which operate on gasoline or natural gas. Among the eight International motor trucks to be shown are three six-wheelers.

The four new International Diesel crawler tractors of which the TD9 is illustrated below operate with drawbar horsepowers ranging from 30 for the TD-6 to more than 70 for the TD-18. Each engine of this new line starts on gasoline and, after about a minute of operation, shifts to full Diesel operation. A conventional automotive-type electric starter may be used. Five forward and one reverse speed is provided in the model illustrated.

The cross section of the new TD-9 Diesel TracTractor has its principal features indicated by number as follows: (1) Double oil pump assures positive full-pressure engine lubrication on all operating angles; (2) large-capacity radiator of fin-and-tube type; (3) thermostat-controlled centrifugal pump cooling water system; (4) fuel-injection pump with built-in, variable-speed governor; (5) heavy-duty, four-cylinder, valve-in-head engine; (6) replacable cylinder liners; (7) single lever for manipulating starting mechanism; (8) heavy-duty, five-bearing crankshaft, rifle-





drilled for lubrication; (9) heavy-duty, single-plate, 13-in. over-center engine clutch; (10) clutch brake for fast gear shifting; (11) controls conveniently located; (12) spring-cushioned seat; (13) five-speed transmission mounted on ball bearings; (14) numerous ball bearings; (15) bevel pinion and gear in separate sealed compartment from steering clutches; (16) pivot axle shaft, on which the track frames are mounted through a ball-and-socket joint; (17) heavy-duty drawbar; (18) welded steel track frame with four lower track rollers, two upper track rollers, front idler, and recoil spring; (19) track shoes are keyed to track chain to eliminate loosening of track shoes. Eleven penetrating lugs on each side assure positive traction; (20) heavy transverse spring cushions tractor from road shocks and permits free track oscillation.

The Buckeye Traction Ditcher Co., will exhibit for the first time, following a thorough test period, their new Model 12-A ditcher illustrated above.

Principal features include the excavator differential, excavator drive consisting of the constant-center drive which assures proper chain tension and eliminates idlers; 6 cylinder industrial power unit with special oil sump for hilly work; lower truck rollers on digging frame which have non-revolving shafts; double bearings in each wheel and rims renewable without disturbing bearing set-up; hoisting feature by means of which front and rear ends of digging frame can be raised or lowered independently or simultaneously.

The conveyor guide clip which is confined entirely to space between pulleys instead of passing over them, is designed to extend the life of pulleys and conveyor belting; gears and sprockets on traction drive, crawlers and excavator wheel are flame hardened; shafts are heat-treated, turned and ground alloy steel with splined sections instead of keys for mounting all driving members, thus simplifying field service.

This new model has a master clutch of the 13 in. spring loaded disc type and unit transmission with 5 speeds forward, one reverse and helical gears in top three speeds. The excavator clutch is the positive gear tooth type, fully enclosed. Traction transmission has 12 forward and 3 reverse digging speeds for each unit transmission speed. The final gear drive has spiral bevel gears, mounted on splined shafts turning in anti-friction bearings.

Cutting dimensions are 24 in. wide by 5½ ft. deep. The height of the machine is 8 ft. 2½ in. by a width over crawlers of 6 ft. 5¾ in. by 24 ft. 2 in. long.

The Cleveland Trencher Company is exhibiting several new pieces of pipeline equipment, the Cleveland Model 140 Pipe Line Trencher and the Cleveland Model 90 Backfiller and Pipe Crane.

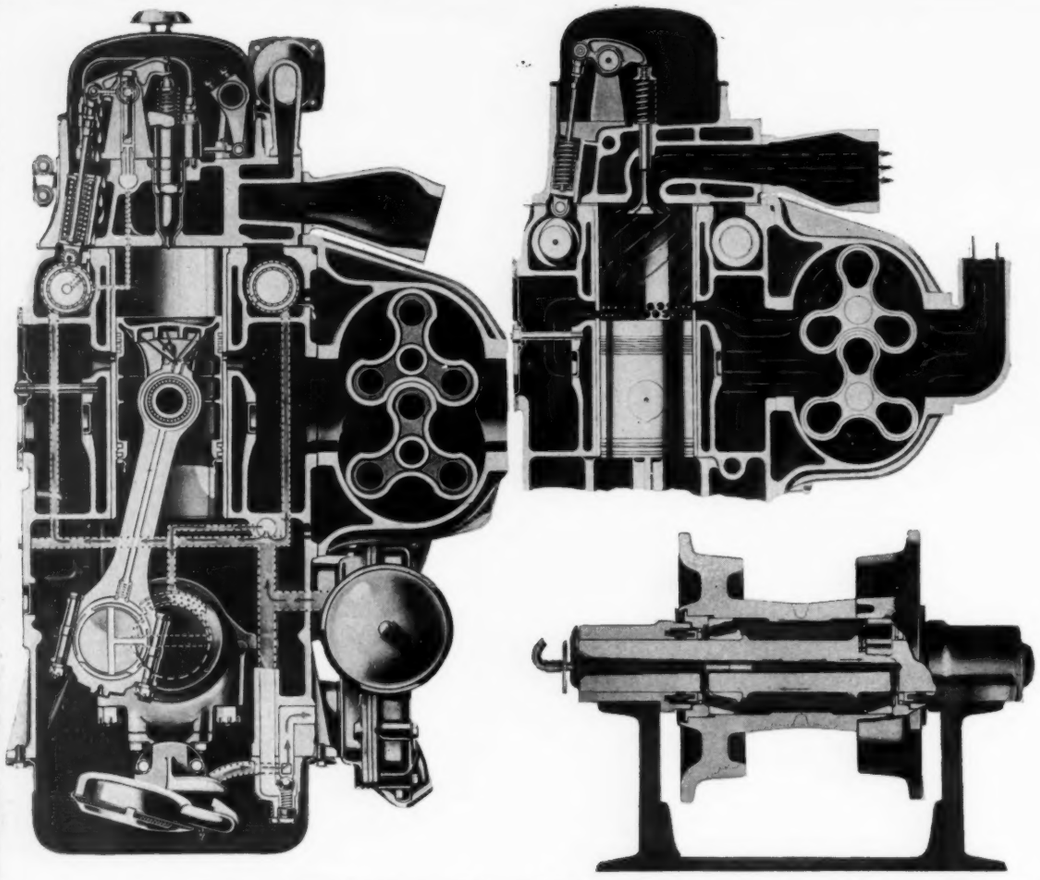
The Model 140 ditcher illustrated below is new and has been expressly designed for pipeline work with broad tread, longer and wider crawlers, more rugged frame and boom, and wider digging widths. This machine can cut trench 18 in. to 30 in. wide and up to 5 ft. 4 in. deep. The 16 in. wide crawler shoes give better traction and low ground bearing pressure enabling the digger to work over soft, marshy ground.

Steering is controlled by foot pedals. When pressure is applied to either pedal, the machine turns in that direction while pressure applied to both pedals simultaneously, acts as a braking system, completely stopping the machine. This proves a valuable safety feature when working in mountainous regions.

The Cleveland Model 90 is a one-man-operated, continuous travel machine that serves as a backfiller as well as a pipe handling machine. This machine can backfill at speeds ranging from 3½ ft. to 45 ft. per minute in either direction. Cable drum speeds are high, ranging from 142 to 212 ft. per minute on the pull-in drum, and from 237 to 355 ft. per minute on the throwout drum. Two to three miles of trench can be filled in a day's time even in rough country.

This model can be converted from backfiller to pipe crane. The machine is equipped with a telescopic boom of strong, latticed type construction which permits the handling of heavy loads. It is adjustable from 13 ft. to 20 ft. in length. Loads of 3,500 lbs. can be handled 10 ft. out from the track while at a distance of four feet from the track edge, it can lift a load of 10,000 lbs. As a pipe crane, it can be used to lower in slack loops, load and unload pipe from trucks and freight cars and line up pipe for tacking welds.

Also designed for pipeline use, like the Model 140 Ditcher, this Cleveland can operate on rough right-of-ways, for new, high crawlers which are 16 in. wide give it great stability and good ground clearance.



Three new Diesel tractors will be exhibited by the Allis-Chalmers Mfg. Co. at the Tulsa oil show.

For the first time 2-cycle Diesel power is available in a crawler tractor. The Model HD-14, largest of the three, is powered by the 6-cylinder General Motors, 2-cycle Diesel, develops 130 h.p. on the belt, 108 h.p. on the drawbar and weighs approximately 27,800 lbs. The Model HD-10 is powered by the 4-cylinder G. M. 2-cycle Diesel engine, has 86 belt horsepower, 72 drawbar horsepower and weighs about 20,000 lbs., while the smallest of the three, the Model HD-7, develops 75 belt horsepower and 54 drawbar horsepower from the G.-M. 3-cylinder 2-cycle Diesel.

The 2-cycle Diesel differs from the 4-cycle conventional engine in that every down stroke is a power stroke instead of every other down stroke as in the 4-cycle engine. The 4-cycle engine operates half the time as an air pump, the other half it develops power as an engine. The 2-cycle engine eliminates these two air pump strokes, pumps its air with a small efficient blower separate from the engine, and therefore, operates all the time as an engine. Operation of the 2-cycle Diesel engine is quite simple. The blower traps the air and carries it into the air box which completely surrounds the cylinders. As the piston nears the bottom of its power stroke, the exhaust valves open and the piston uncovers the intake ports in the cylinder wall. A blast of cool air from the air box rushes through the cylinders, forces the burned gasses out of the exhaust valves and cools the exhaust valves as it goes by. Thus the cylinder is filled with fresh air, the exhaust valves close trapping the air in the cylinder and piston, moving up on the compression stroke, closes the intake ports. The direction of airflow is illustrated by red arrows in the above cross-section on the right top of the group of drawings. Fuel is injected at the top of the compression stroke and the piston is forced down on another power stroke.

Because the 2-cycle engine delivers twice as many power strokes as the 4-cycle type, it is an unusually smooth running engine and has the added feature of unit injection which makes precombustion chambers unnecessary for proper burning of fuel. The unit injector is actually a combined injection pump and injection nozzle and one unit injector mounts in the cylinder head over each engine cylinder. It operates from the same camshaft as the engine exhaust valves and with the same type of push rod and rocker arm. No precombustion chamber is needed; thus the injector is cooled in three ways, since it is completely surrounded by the engine cooling water, the tip is cooled by the incoming air blast, and a continuous flow of fuel oil through the injector body actually carries away heat from the inside of the injector. This continuous flow of fuel through the injector also prevents all possibility of air lock.

Another recent development is the use of Velvetouch bi-metallic friction material in steering clutches and brakes. Powdered graphite, iron, bronze and other substances are formed under enormous pressure and heat, and welded by a special process to a steel disc to form a steering clutch driven disc. For the braking surface it is welded to curved steel plates to form blocks which in turn are riveted to the brake band. Because of its special composition, it can resist high temperatures present in continuous work.

Longer track life has been made possible in the new Diesel tractors through the use of a new type of track release mechanism. A track release mechanism is necessary on a crawler tractor so that the front idler may move back against a spring to prevent breakage when stones or other foreign objects lodge between the sprocket or idler and track. The new track release mechanism is first of all sealed in oil so that no dirt or foreign material can enter to prevent its performing this very necessary function.

All of the new Diesel tractors are equipped with the new "Positive Seal" roller bearing truck wheels and idlers which is illustrated at the bottom right of the above group of sectional drawings. This new development makes it unnecessary to grease truck wheels at all. The oil in the truck wheels is changed every 200 hours. The "Positive Seal" consists of two steel sealing rings held tightly together by means of a ring of compressed Neoprene. One seal ring rotates with the truck wheel, the other is stationary on the shaft. These two polished surfaces pressed tightly together form the seal and are lubricated from the oil reservoir in the truck wheel. Tapered roller bearings are used to reduce friction in the truck wheel itself.

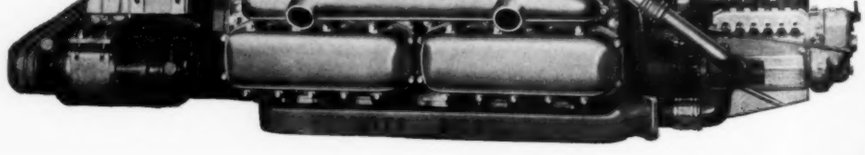
A number of Hercules engines and power units are being shown at the Hercules exhibit at the International Petroleum Exposition. Ranging from 4 to 200 h.p. these include both gasoline and Diesel engines and power units in two-cylinder, four-cylinder and six-cylinder high-speed, heavy-duty models.

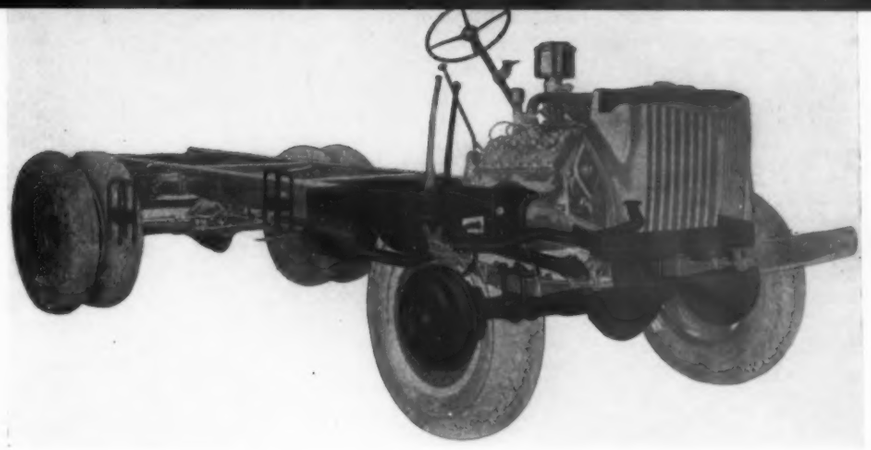
A feature of the exhibit will be the new DIX Series of two-cylinder, high-speed, heavy-duty Diesel engines and power units. This Diesel is primarily built for hand starting.

The fuel pump and governor were incorporated in the design of the cylinder block itself. The replaceable fuel plungers are driven by the engine camshaft. An enclosed governor is mounted on the camshaft gear. There are only three gears in the front of the engine, these being crankshaft, camshaft and lubricating oil driving gear. The timing gear housing, the tappet and the rocker arm compartment are air-tight, sealed from the crankcase.

Series DFX Diesels are furnished in horizontal, on-the-angle and vertical models. A horizontal DFX model is illustrated below.

Among the units on display at the Marmon-Herrington exhibit at Tulsa are several models of Marmon-Herrington all-wheel-drive Fords and heavy-duty trucks with gross capacities up to 70,000 lbs. In addition, there will be a stripped chassis of a Marmon-Herrington All-wheel-drive Ford illustrated





at the top of this page showing standard Ford and Marmon-Herrington conversion parts painted in contrasting colors; cut-away working models of Marmon-Herrington constant velocity joint steering ends, auxiliary transmissions, power take-offs, etc.

Essential difference between Marmon-Herrington all-wheel drive Ford and the conventional Ford, is, of course, that in the former, traction is developed by all the wheels instead of only the two rear wheels. In order to make this conversion, the following steps are taken in the Marmon-Herrington plant:

(a) Original front axle assembly is removed.

(b) New driving front axle is installed, with standard Ford differential gears, and with special Marmon-Herrington designed constant velocity universal joint steering ends to permit front wheel steering.

(c) New Marmon-Herrington designed two-speed auxiliary transmission or transfer case is installed.

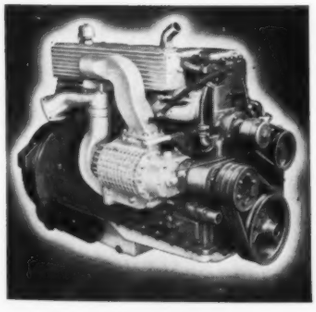
(d) Necessary changes are made in steering assembly and hydraulic brake connections.

(e) If six wheel All-Wheel-Drive is required, larger frame and additional driving rear axle and wheel assembly are installed.

(f) Tires and other accessories are replaced where necessary, and special bodies installed as required.

(g) Each unit used in construction is thoroughly tested before assembly, and each complete Marmon-Herrington All-Wheel-Drive Ford is tested under actual working conditions by experienced Marmon-Herrington engineers, before shipment.

This year, at the Oil Show, Cummins Engine Company is putting on display for the first time, their latest supercharged unit. This engine, using a supercharger, develops 325 h.p. at 1,000 r.p.m. It is illustrated directly below and particular attention is called to the compact, light-weight super-charger.



Over-all dimensions are practically the same.

In addition to this new model, Cummins are showing three other supercharged Diesels —the Model HPS-601 power unit with outboard bearing, six cylinder, 4⅞ in. bore, 6 in. stroke, 672 cu. in. displacement producing 170 h.p. at 1,800 r.p.m; two marine engines equipped with reverse and reduction gears—the first, a 6 cylinder, 4 in. bore, 5 in. stroke, producing 135 h.p. at 2,220 r.p.m., and the second, also a 6 cylinder model, with 4⅞ in. bore, 6 in. stroke, 672 cu. in. displacement, 200 h.p. at 1,800 t.p.m.

Two more Diesels are on display. The small truck engine, which produces 100 h.p. at 2,200 r.p.m. is being shown as well as a full size cut-away model of the 150 h.p., 6-cylinder type.

The new supercharged models, like all Cummins Diesels operate on the four-cycle principle, have the same bore and stroke as the standard models and develop their maximum horsepower at standard engine speeds. There is no appreciable increase in weight or dimensions over standard models.

The smaller models of supercharged Cummins Diesels weigh only 10 lbs. per horsepower, including the weight of standard equipment such as the fuel distributor pump, electric starting equipment, etc. The newest supercharged heavy duty engine weighs only 24 lbs. per horsepower.

The fundamental principle of supercharging the Cummins Diesel is to put more air into each cylinder which makes possible the burning of more fuel or a more efficient burning of a given fuel charge on each power stroke. When either of these occur, naturally there is a corresponding increase in the volume of expanding gas. This increases the mean effective pressure on the piston over a longer period of time during its power stroke.

The supercharging unit itself is only a small compressor or blower which creates a pressure behind the air entering the Diesel through the intake manifold. The supercharged Cummins Diesel has approximately 7 to 8 lbs. of air pressure in each cylinder at the start of the compression stroke whereas unsupercharged high-speed engines, gasoline or Diesel, are likely to have a negative pressure or a slight vacuum.

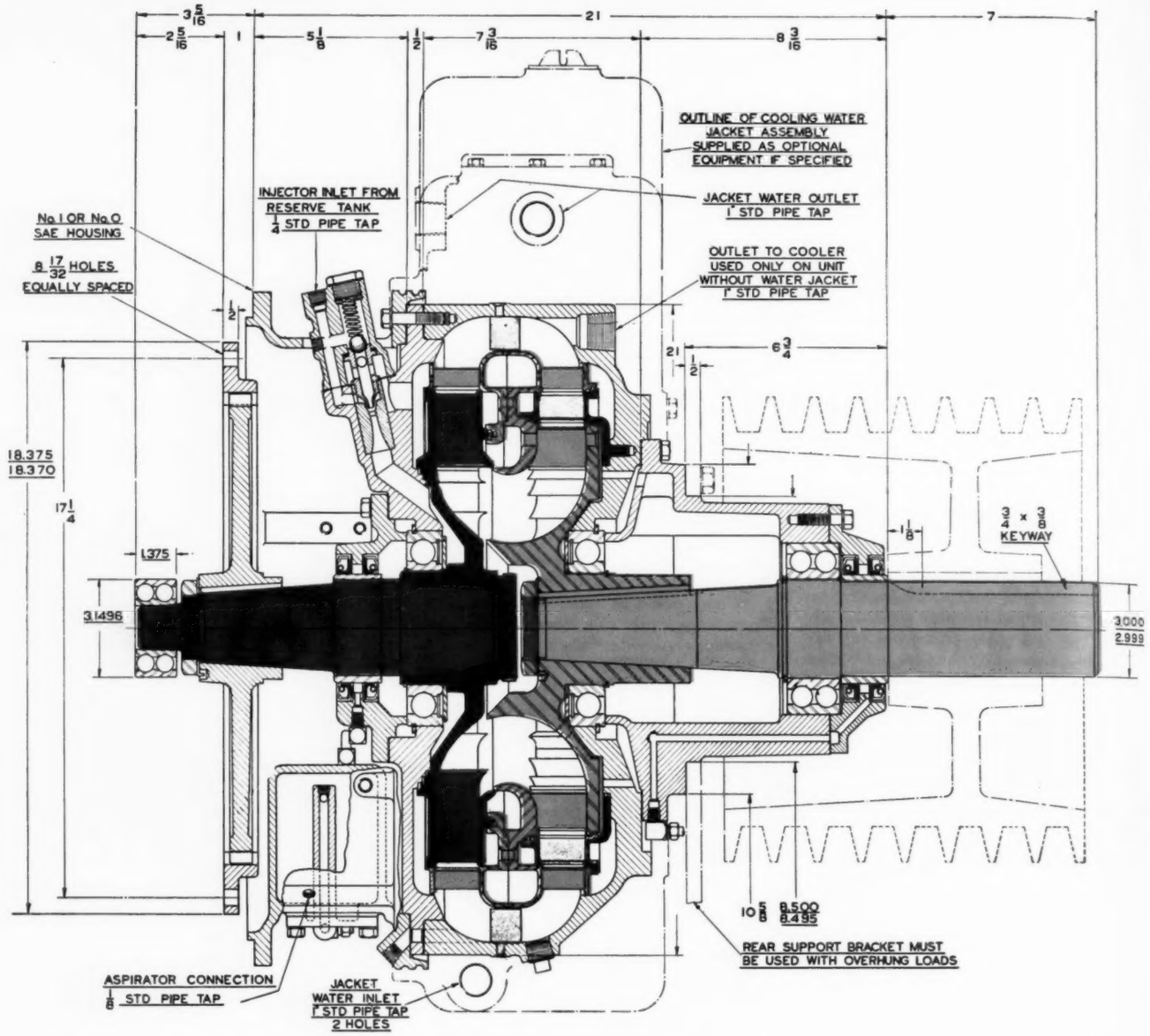
The blower or supercharging unit itself is attached to the manifold side of the engine and is belt driven through a slip clutch from the front end.

Mounted on a "Caterpillar" Diesel D4 Tractor, a new piece of loading equipment, known as the Athey MobiLoader, is being exhibited at the International Oil Exposition at Tulsa, by the Athey Truss Wheel Co.

The MobiLoader illustrated at the bottom right hand side of this page has a 1½ yard bucket which dumps to the rear without the necessity of turning or maneuvering the tractor in any way. It can also be arranged for front end dumping. Rear dumping is controlled by a single lever within reach of the tractor operator and a separate lever is provided to trip the bucket when dumping forward.

There is 7½ ft. clearance under the rear dumping chute, and, when dumping forward, the load may be discharged at any point from the ground to the same height.

Power is transmitted from the front power take-off on the tractor through a universal joint which extends back to a reversing transmission and worm gear unit, mounted on the left-hand fender. This power unit is connected directly to a pair of cable drums on which the load cables are wrapped.



Headlining the exhibit of the Twin Disc Clutch Company at the International Petroleum Exposition is the new Twin Disc Hydraulic Torque Converter illustrated diagramatically at the top of this page. Capable of giving an internal combustion engine flexibility approaching that of steam performance, a number of these units are already in operation on rotary and cable tool drilling rigs and hoists.

In addition to the torque converter, the Twin Disc exhibit will include Power Take-Offs, and heavy-duty, friction disc clutches.

The torque converter is a hydraulic unit, which, when used in connection with an internal combustion engine, permits constant speed operation of the engine regardless of the speed of the driven unit.

The drooping, torque-speed characteristic, especially advantageous for the starting and accelerations of heavy loads, is obtained at the output shaft of the converter in the form of high torque at low speeds, which is reduced automatically as the speed increases. Even with the output shaft of the converter completely stalled due to extreme load conditions, the engine cannot be stalled but will continue running at its normal operating speed. Under these conditions, a maximum of approximately five times the engine torque will be available on the output shaft of the converter.

The construction of the converter is based on the hydro-kinetic principle. Its operation depends on the circulatory movement of the fluid for the transmission of power. Because the hydraulic drive does not require a rigid connection between the engine and the driven equipment, the fluid drive, attained with a converter, absorbs the cyclic variations of an engine, shock loads, and provides for smooth starting of the load.

The hydraulic portion of the converter consists essentially of three major parts (see accompanying illustrations at the top of the page): the pump, the turbine, and the stationary housing.

The pump, which is coupled to the engine, absorbs the power delivered by the engine and converts it into circulation of the fluid, thus creating a fluid head.

The multiple stage turbine, which is connected through the output shaft to the driven equipment, absorbs the fluid head built up by the pump and converts it into power. The turbine consists of a rotor on which are mounted three separate rows of blades.

In the stationary housing, two rows of blades are mounted; located so that they fit between each of the three turbine stages, respectively.

The design of the Waukesha unit for full scale, single cylinder, testing of aviation engines is being featured in the Waukesha exhibit at Tulsa. As shown in the illustration at the bottom of the opposite page, a massive

iron crankcase forms the base which is divided into separate compartments, each sealed from the other for isolated study of lubrication problems. The crankcase compartment is an integral unit. The timing gear compartment is an integral unit, and in the base is a separate unit housing a Lanchester balancing system which is driven from the crankshaft and is designed to permit speeds up to 3000 r.p.m. with practically no noticeable vibration. There are two sets of weights in the base, one operating at crankshaft speed to balance out the primary reciprocating forces and the other pair of weights running at twice engine speed to balance out the secondary unbalanced forces.

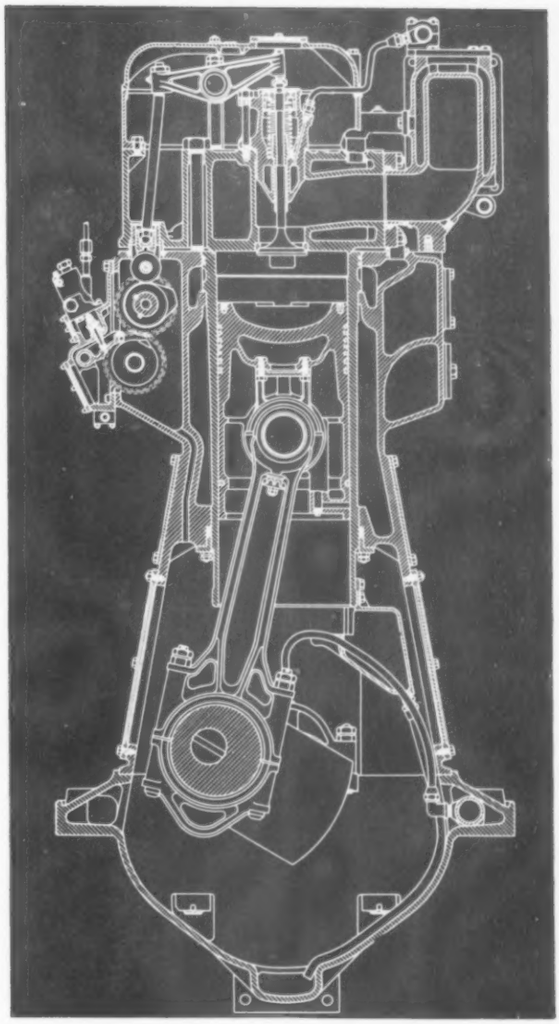
This engine is fully operated at Tulsa with thermo-couples and controls indicating temperatures at every point within the engine and in the cooling fins. Full laboratory cooling system is installed and gasoline injection is used.

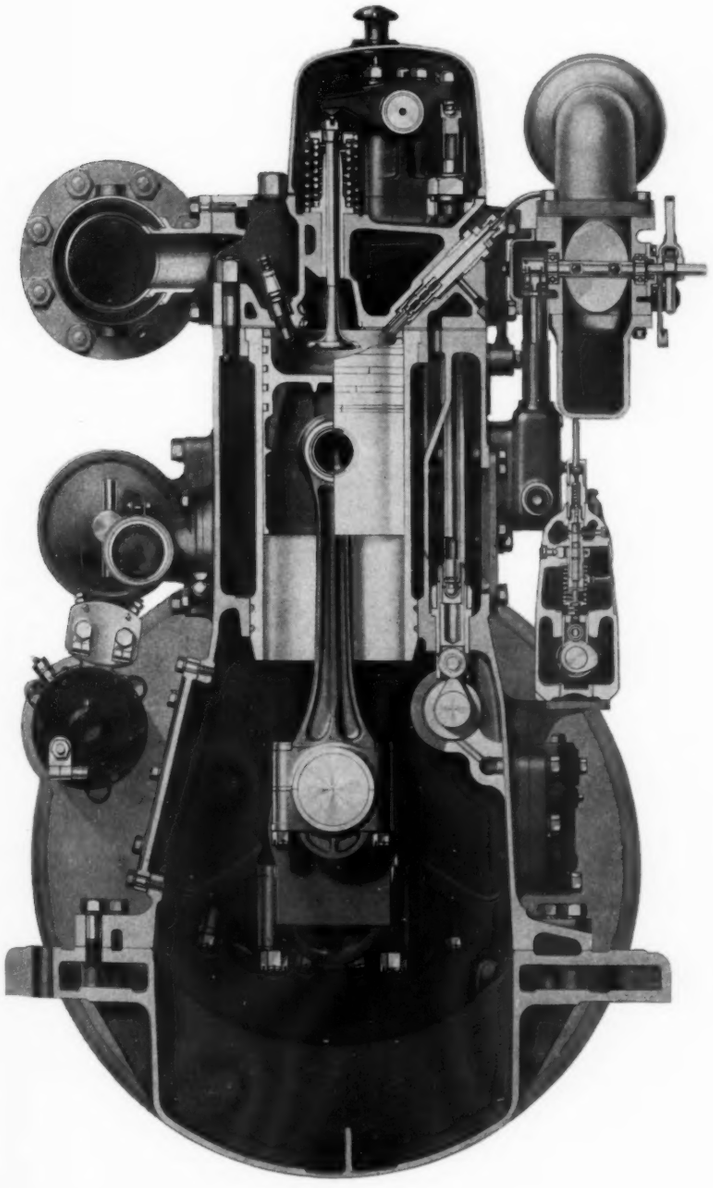
The newest development of Waukesha commercial engines is embodied in the new Multi-Fuel design which is arranged to burn Diesel oil, natural gas, butane, propane, and a whole host of liquid and gaseous fuels with no internal change whatever and with only external accessories which are directly concerned with the fuel system. Two engines of this type are in operation at the Exposition.

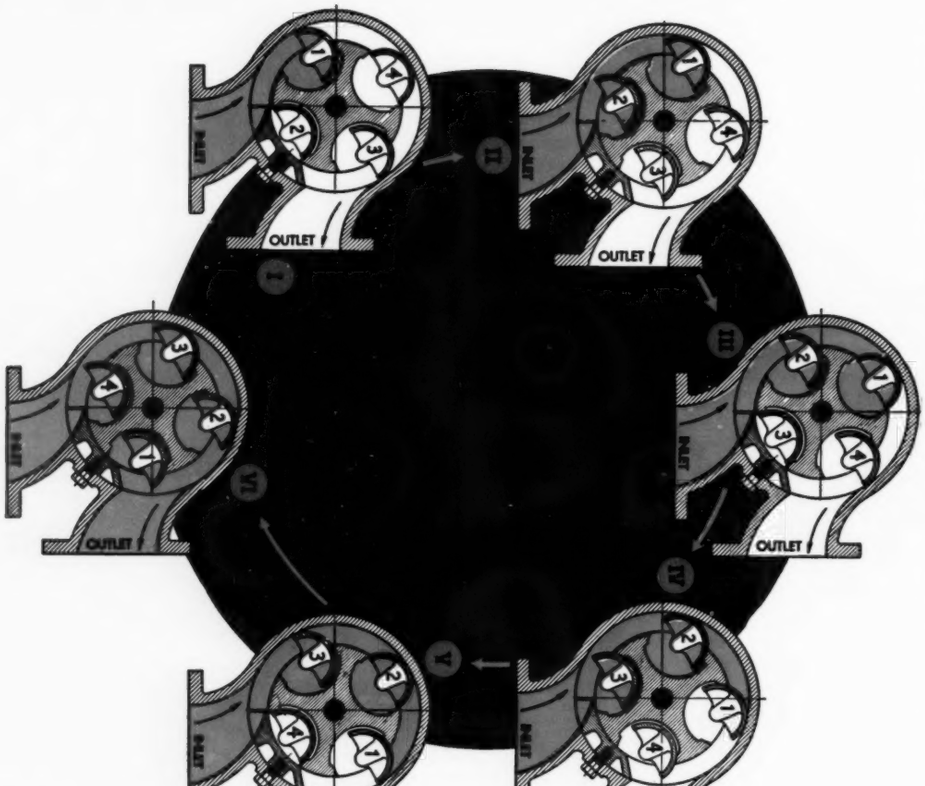
Cross-section of a Cooper-Bessemer type JS Diesel engine is illustrated at the top right hand side of this page. The Cooper-Bessemer JS series is new and is being featured at the Cooper-Bessemer display at the oil show. Points that merit particular attention are the oil cooled pistons, full pressure lubrication, individual cylinder heads and precision camshaft bearings. This unit is convertible from Diesel to gas fuel. All fuel injection mechanism is located on the camshaft housing where it is readily accessible. Short tubes connect the fuel injection to the spray nozzles in the cylinder heads. By disconnecting the tube, the head may be removed and cleaned without disturbing injection valve adjustments. Cylinder bore is 13 in. and the piston stroke is 16 in.

The base and counterframe join at a point close to the horizontal centerline of the crankshaft. Steel bolts extend upward from below the main bearings in the base and tie the base, centerframe and cylinder block together. Separate, removable cylinder liners of the wet type are fitted with oil-proof rubber grommets at the upper and lower ends to seal the water joints. The crankshaft is a one-piece steel forging with 9 in. diameter (70 percent of the bore). Main bearings are babbitt lined shells with shim adjustment.

The connecting rods are of die-forged steel fitted with two-piece, automotive type crankpin bearings and have shim adjustment. Piston pin ends of the connecting rods are bolted solid to the piston pins which float in the pistons. The pistons themselves are oil-cooled by means of a constant flow of oil through a fully enclosed chamber beneath the piston crown. A gear-type lube oil pump serves the full pressure circulating type lubricating system. Oil is delivered under pressure through a filter and cooler to a header in the engine base, thence to the main bearings and from these to the crankpin bearings, and is then forced upward through the drilled connecting rod. From the connecting rod, oil reaches the piston pin bearing and passes up into the piston crown, then downward through the piston wall to a ported opening.







The Pittsburgh Equitable Meter Company's Rotocycle is a positive displacement meter of the rotary type designed especially for the measurement of crude or refined petroleum products in gathering lines at pipeline pumping stations, or for bulk plant tank truck service. It is being displayed at Tulsa along with the Nordstrom Hypreseal standard production valve and the Emco forged steel orifice meter.

The Rotocycle is a positive displacement meter having an operating mechanism consisting entirely of rotating parts. The meter body is a cylindrical housing in which a measuring element, called the rotor, is revolved by the flowing stream. Inlet and outlet ports, situated at a 90 deg. angle to each other on the circumference of the meter body, are so designed that the flow of liquid moves in an unrestricted path. The inlet and outlet ports are separated by a division plate which marks the beginning and end of each measuring cycle. The meter body is so installed in the line that liquid enters from the bottom, flows through 270 around the measuring chamber and out at the side.

The rotor, or measuring element, is a cylinder carrying four half-moon shaped buckets equidistantly spaced on its outer circumference. The rotor is turned with the moving stream by the pressure of the incoming fluid acting upon these buckets. They are geared together in a ratio of one to one on top of the rotor. As the rotor turns, the position of the buckets with relation to the side walls of the circular measuring chamber varies, always, however, so that two buckets are in position to form a closed compartment. Volume in this compartment is a definite displacement and a certain number of these displacements are counted and recorded for every gallon passing through the meter.

The above diagrams trace the progress of fluid through the measuring chamber of the Rotocycle Meter. Six of the many positions assumed by the rotor during one revolution are shown. These positions are indicated by Roman numerals I to VI. The four half-moon shaped buckets which are attached to the rotor are numbered from one (1) to four (4). Fluid is indicated in red.

For purposes of demonstration it is assumed that the measuring chamber is empty prior to starting this measuring cycle. Actually, measurement is accomplished as a continuous series of cycles with the measuring chamber always full of liquid.

Position I—Liquid entering the measuring chamber through the inlet port and under pressure encounters bucket number (1) which seals off further progress.

Position II—Pressure under bucket number (1) forces the rotor, to which the buckets are attached, to turn on its center shaft. This moves bucket number (2) into the stream.

Position III—Bucket number (2) has now reached the point originally occupied by bucket number (1), where it seals against the wall of the measuring chamber. Segregated now between bucket (1) and bucket (2) is a definite volume of fluid—which is the actual measured volume per cycle. By means of suitable gearing attached to the shaft of the rotor, these measured revolutions are counted and recorded on the register in gallons or barrels measured.

Position IV—It will be noted that the displaced volume between buckets (1) and (2) has moved forward without change in area. Bucket (3) has now come into the flowing stream.

Position V—Bucket (3) has reached the seal position. Between it and bucket (2) is another measured volume. The measured volume between buckets (2) and (1) has moved forward to the point where discharge into the outlet port is about to begin.

Position VI—The measured volume between buckets (2) and (1) is now being discharged into the outlet port. The volume between buckets (3) and (2) is moving forward towards the discharge. Bucket (4) comes into the flowing stream to start a new cycle.

The Nordstrom Hypreseal valve is designed for extreme conditions of pressure temperature and abrasion, and is made in both round opening and rectangular opening types.

The valve plug is a separate conical member, accurately fitted to its seat in the body. The plug is assembled to the body through the bottom opening which is then closed by a rigid, screwed member or sealing plug. Threads are sealed by a plastic packing material applied through circular grooves cut into this screwed member. The function of holding the valve plug in its seat is performed by a heavy spring plate interposed between the threaded bottom member and the bottom of the valve plug. The spring plate is unaffected by internal pressure and at no time is there any fixed clearance between the plug and the body.

The valve plug is rotated by a separate stem which is threaded through the upper part of the body. The stem is joined to the plug through a floating equalizer fitting so that the two parts rotate together, but are independent as to lengthwise movement. A secondary seal, which is called upon principally to prevent the slow escape of lubricant past the stem threads, is provided by compressing a plastic fibrous packing material into an annular recess near the outer end of the stem by means of a compression screw and check valve fitting which permits additional packing to be inserted without removing pressure from the valve.

In the Emco Orifice Meter also being displayed by Pittsburgh Equitable Meter Co. the float is in the low pressure chamber, rising with increase in mercury level. The gauge case is secured to the manometer, locating the differential pen over the upper right hand side of the chart.

Two types of Crosby Liquid Level Gages are being exhibited at Tulsa for measuring the height of liquids in tanks, reservoirs, vessels, etc., with the gage remotely located. The diaphragm bell type is suitable for measuring height of any liquid not corrosive to bronze or whose temperature does not exceed 120 deg. F. This gage consists of a standard pressure gage connected by means of copper

tubing to a cast brass bell with a diaphragm in the open bottom. The diaphragm is made of gum rubber or with synthetic oil-resistant rubber for oil service. The bell is located at the bottom of the tank or vessel and supported by means of a chain where the liquid is motionless. If the liquid is turbulent, the bell may be rigidly supported. For service in connection with a standpipe the bell may be furnished with a closed bottom and a ½ in. pipe connection for mounting outside the tank.

The airflow type liquid level gage is designed for use where it is impractical to install the diaphragm bell or where the liquid is corrosive to bronze, or where the temperature is above 120 deg. F. This gage consists of a standard indicating gage connected by means of copper tubing to an open pipe set into the liquid to be measured. An air supply connected to the system forms an air column in the pipe equal in pressure to the head of liquid surrounding the pipe. The gage indicates height of the liquid by measuring air pressure. Two types of airflow gages are furnished. Type 1 is used where a continuous air supply is available. A pressure reducing valve is employed and is adjusted to maintain a slight excess of air pressure to keep the liquid out of the pipe, and permit the air to bubble slowly through the liquid. This gage gives a continuous indication of height of liquid. Type 2 is used when no air supply is available. A small hand pump provides the air pressure and permits intermittent reading of the gage.

Both diaphragm bell and airflow types of liquid level gages are furnished with 4½ in. to 12 in. diameter gages in iron or brass cases. Diaphragm bell type gages may be located 500 ft. from the tank where the height of liquid is not greater than 30 ft. or may be located 60 ft. from the tank where the height of the liquid is 100 ft. For airflow gages, Type 1, the gage may be located 500 ft. from the tank, and for Type 2, 100 ft. from the tank.

The Taylor Instrument Companies have introduced a completely redesigned line of new Fulscope air-operated recording and indicating controllers for temperature, pressure, rate of flow, and liquid level. These are being displayed at the Tulsa oil show and one of them is illustrated at left.

Combining in one instrument the conventional proportional response and automatic reset forms of control, the new Fulscope also introduces a third process-control effect, Pre-Act. Pre-Act is a supplementary control feature which makes control-valve corrections according to the rate of control-point deviation. In response to sudden disturbances in the process or variations in the controlling medium, over-peaking or oscillating is greatly reduced by an immediate and relatively larger control-valve action than would occur otherwise. Furthermore, it stabilizes operation after a change in set point.

W-K-M pipe cleaning machines one of which is illustrated at the bottom of this page, are being demonstrated at the Tulsa Exposition.

The machine travels under its own power, along a made up line, cleaning, or cleaning and priming the pipe as it moves along. For handling single joints, stationary machines, or traveling type machines mounted on stationary bases, are used.

Dependent upon the characteristics of the work involved, the machines are readily set up with the following basic elements, either singly or in combinations:

A. A series of many toothed, hardened steel cutter wheels, for removal of rust, dirt, or in the case of new pipe, the mill scale.

B. Sets of steel wire brushes, for polishing the pipe behind the cutter wheels, or for rapid removal of rust and dirt accumulated during shipping and stringing the pipe.

C. A priming head, which by means of special fibre paint brushes, and a wiping rug, applies the priming paint evenly and without waste.

D. Where old coating, felt wrappers, etc. are to be removed, the machine may be equipped with special knives, which dig under and actually cut such materials from the pipe.

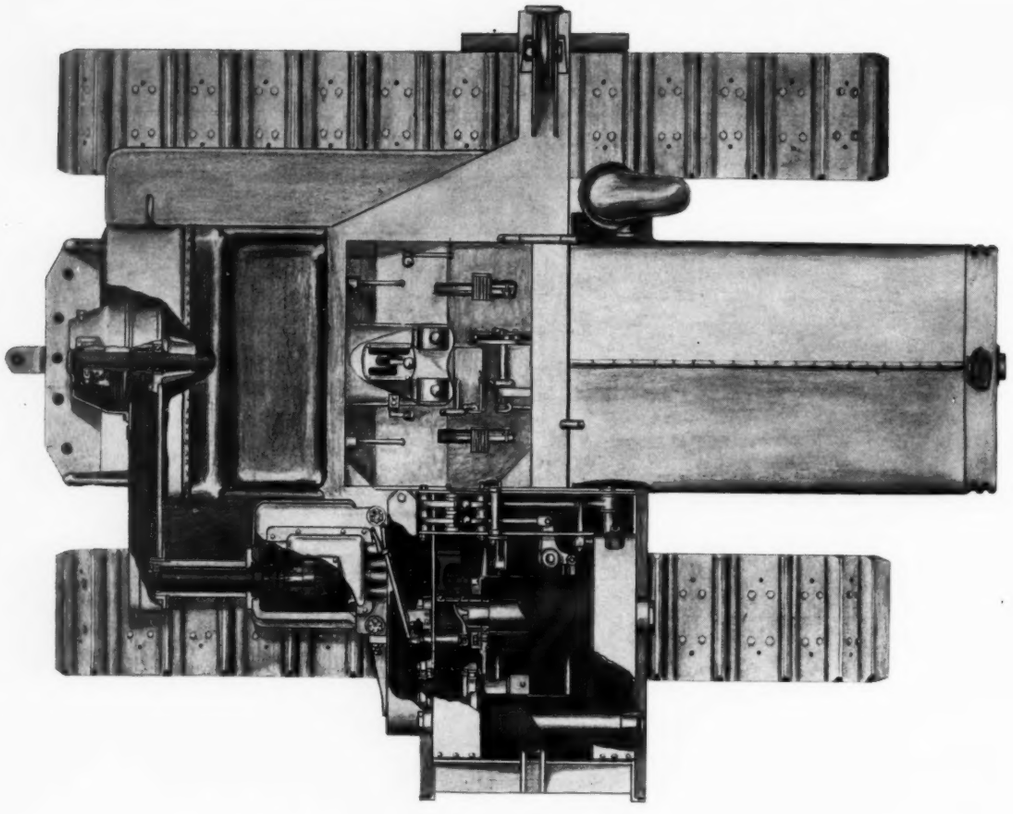
Each of the cleaning elements is flexibly mounted, so that as it reaches a collar or weld, it merely expands slightly, cleaning the collar or the weld and proceeds without interruption.

The machines are all readily changed to handle several sizes of pipe without additional parts.

The Landis Machine Company, is exhibiting its 13⅜ in. pipe threading and cutting machine with the receding chaser die head, illustrated in the center, right hand side of this page. This machine is being demonstrated on 8⅝ in. seamless steel casing. In addition to being used by the manufacturers of oil well tubular goods, this machine is also used in the oilfields by users of casing, tubing, and drill pipe.

The Landis receding chaser pipe machine covers a wide diametrical range of sizes from 4½ in. to 13⅜ in. inclusive, and only two sets of chasers are required to cover this entire range as long as the pitch, thread form, and taper remain the same. This feature eliminates the necessity for frequent chaser changes. The taper of the 13⅜ in. Landis pipe threading and cutting machine is accurately controlled and produced through a sine bar which is adjustable and which gradually recedes the chasers as the head is propelled forward by means of a leadscrew.

A feature of the Landis machine which will be on display, is the air operated chucks. The use of air operated chucks increases the operating efficiency of the machine.



The John Zink Co. is exhibiting at Tulsa, along with a complete line of oil and gas burners two entirely new burners. The first of these is the Multi-Way Frame Combination Burner built to receive the working parts of the various types of John Zink burners. Sizes range from 14 in. to 30 in., with capacities from 2,000,000 b.t.u. per hr. to 40,000,000 B.t.u. per hr. Burner is equipped with removable fuel guns and the feather-weight air control door. The second new Zink feature in the exhibit is the Two-Way oil burner, furnished with two heads and can be used as a mechanical atomizing burner or as a semi-mechanical steam atomizing burner by simply changing heads. The mechanical head is a tangential slot whirl type and the steam atomizing head may be drilled to produce type of flame specified. Wall thimbles or air registers of the proper size can be furnished. The oil gun will pass through standard 2 in. pipe and such pipe can be used as a guide or support to hold it in wall thimbles or other types of burner openings.

The Model HD Trackson pipe layer illustrated above is a heavy-duty pipe line machine designed for the largest Caterpillar tractors. In the illustration above, the power train is indicated in red, the load drum and the boom drum in blue. The boom drum is just below the load drum.

The operating mechanism is mounted on the side of the tractor opposite to that of the boom, so as to obtain maximum of lifting capacities. Power is from the rear power take-off of the tractor through a ball bearing mounted two-plate, Twin Disc friction clutch. Operation is, therefore, independent of the tractor master clutch.

Both boom and load line drums are free-running and provided with separate clutches and brakes which permit the load to be dropped or held against the brake if desired. A heavy automotive type transmission gives four speeds forward and one in reverse on both drums.

The frame is a rigid, all-welded box-section structure attached to the track frames of the tractor unit. Provision is made on the left side of frame for attaching up to 3,500 lbs. of segment counterweights. These are mounted close to the tractor so as to be non-obstructive for work in close quarters.

The machines are equipped with cable and blocks. The standard length boom is 15 ft., constructed of 6 in. 25 lb. steel H-beams and pivots on a sub-frame which is attached to the left track roller frame of the tractor.

All control levers are integral with the winches, convenient to the driver's seat. The load line drum is equipped with a "Spring-Loaded" brake, while the boom line drum has a safety ratchet synchronized with the transmission.

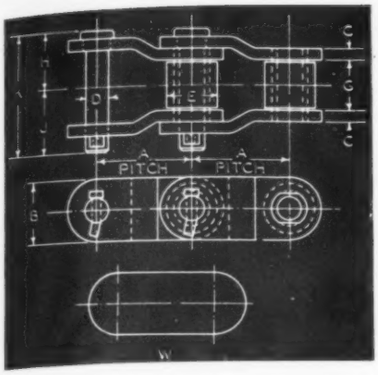
Beaver Pipe Tools, Inc., are showing at the Tulsa show a new light-weight, portable pipe and bolt threading machine known as Model-B which is illustrated at the bottom of this page. This new machine cuts, threads and reams from ⅛ in. to 2 in. pipe. It cuts bolt stock from ¼ in. to ⅜ in. and threads it from ¼ in. to 2 in. By means of a drive shaft it will operate geared cutting and threading tools from 2½ in. to 8 in.

The die heads are the quick-opening, fully-adjustable ring-type with no lower hinge. These die heads are adjustable for over or under-standard. A ball-bearing wheel-and-roller cutoff is used for cutting both pipe and bolts. The slight burr produced by the thin wheel is removed by the ⅛ in. to 2 in. alloy tool-steel cone reamer.

Model-B employs a universal motor that operates on A. C. or D. C. of any cycle 25 to 60. It is a ½ h.p. motor that develops 1.6 h.p. through the gearing.

Model-B is right-handed, like a lathe. All operating controls are at the operator's finger-tips and 13 in. of open working space is available between the chuck and the die head. The die heads and the cutoff as well as the reamer are controlled by the rack-and-pinion feed. A standard 3-jaw Cushman Universal Gear Chuck is used for gripping the pipe. An automatic chuck wrench ejector and an adjustable pipe support, independent of the spindle, to absorb pipe whip and prevent flat-sided threads are included. All gears are fully encased and automatically lubricated—seven anti-friction bearings are employed. The machine can be had either with a gear-driven oil pump, with a 1-gallon oil reservoir or with no oil pump. It can also be had with universal quick-opening die heads or with self-contained die heads. It weighs 250 lbs., is 36 in. long by 18 in. wide at the base and is 13½ in. high.

Oil well chains are being shown by Jeffrey Manufacturing Co. at their display at the International Petroleum Exposition. At the



top left hand side of this page (above) is a blue print diagram showing dimensions of a typical Jeffrey Standard chain. In this case the pitch (A) is 3.075 the width of side bar (B) is 1½ in. the thickness of the side bar (C) is 5/16 in. the pin diameter (D) is .625 and the diameter of the roller (E) is 1¼ in. while the width inside is 1½ in. The distance (H) is 1 21/32, (J) 1⅛ and (K) is 3 17/32 in. There are 39 links to the 10 ft. section, the chain weighs 6.8 lbs. per foot and has an average ultimate strength of 48,000 lbs. The diagram (W) indicates the style of the chain.

There are of course, other Jeffrey chains of varying capacity and size adapted to conditions found in oil field work. This particular chain is designed for average depth drilling where moderate speeds and reasonable loads are encountered. The pins are of heat-treated alloy steel and D-shank construction. Bushings are of cold drawn case hardened strip steel. The rollers are machined from solid bars of medium high carbon, heat treated steel. The cotters are the solid grooved pin type.

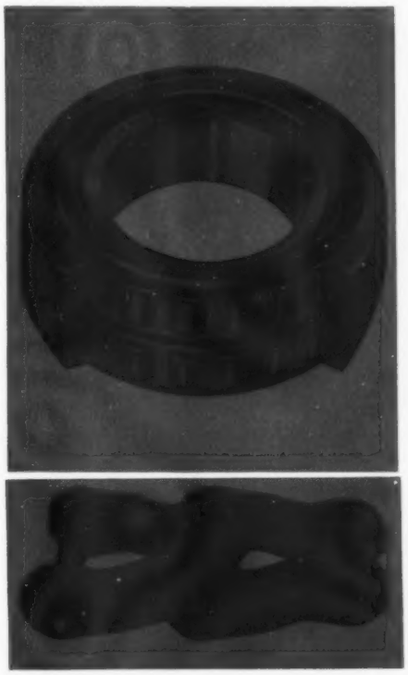
Chain Belt Company's exhibit at the Eleventh International Petroleum Exposition will consist of a display of the various types and sizes of Rex chain belts and sprockets and several sizes of speed prime centrifugal pumps manufactured for oil field use. Included among Chain Belt's display will be: Rex Deepwell, the chain belt for a wide working range in all types of drilling; Rex Champion, a heavier chain with higher ultimate strength, designed for extremely hard and deep drilling; Rex Universal 3125, a chain belt which is designed for tough drilling at higher speeds; Rex roller chain belt, for various types of drilling and drive units in the oil field.

One of the Chain Bolt products to be displayed at the exposition is a new series of even pitch off-set sidebar roller chain belts,

such as the one illustrated at the bottom left hand side of this page. These chain belts are a recent development in chain design for oil field service. They are made in four sizes: 1¼ in. pitch, 1½ in.pitch, 1¾ in. pitch, and 2 in. pitch. They are made in either single or double strands and can also be furnished in other multiple widths.

Rollers are made from solid stock and have a ground finish. Sidebars are die cut and machine beveled. Pins have three diameters and are hardened and ground. The off-set sidebar construction assures each link wearing equally. Pitch elongation due to normal wear is divided over all links. Alloy heat treated steels are used throughout, combining a maximum of hardness and ductility.

The exhibit of Link-Belt Company includes Link-Belt Red-Hed, Hyper, Silverlink roller and Silver-Streak silent drive chains; mud screening equipment; anti-



friction bearings, both mounted and unmounted types; samples of other power transmission equipment, and malleable iron and Promal castings.

Among the chains being featured is Link-Belt's SS-124, A. P. I. 4, Self-Lubricating Three-Bar Hyper rotary chain equipped with oil-grooved drop-forged alloy steel side bar, which permits free entry of oil to chain joint and bearings.

The joint of this chain includes a forged alloy steel pin, machined, heat-treated, ground, and fitted with cadmium plated cotter; alloy steel roller, heat-treated, and with oil hole for lubrication, and an alloy steel bushing, machined, case-hardened, and ground internally and externally, having two oil holes.

An illustration of two links of this chain is reproduced in the center of this page.

The anti-friction bearing display will in-

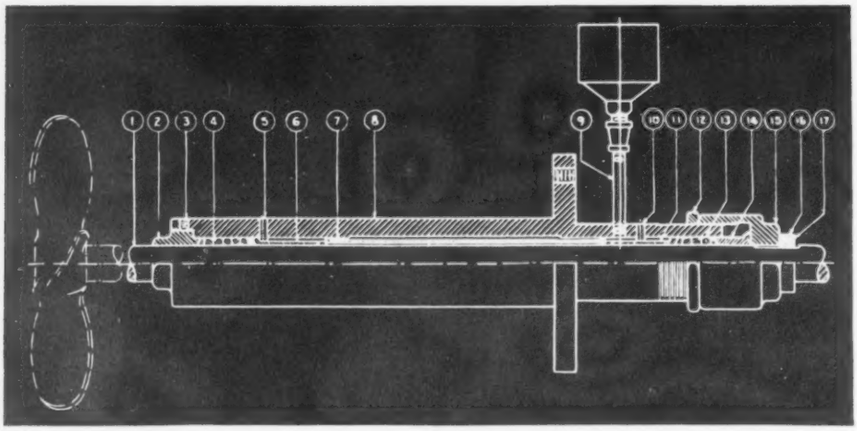
clude samples of The Link-Belt Shafer self-aligning roller bearings of double-row unmounted type which is also illustrated in the center of this page.

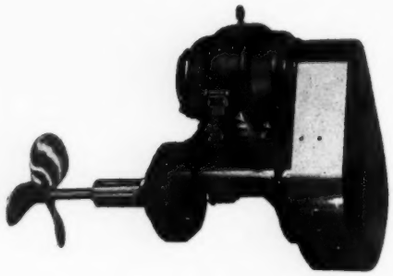
For screening and reconditioning rotary mud, there will be displayed the new Link-Belt dual hook-up. This consists of two 24 in. by 48 in. vibrating screens mounted on skids as one unit, with unitized mud collecting tank and inlet chute, and one motor driving the two screens independently.

The W-K-M Master Scrubbers on exhibition at Tulsa are designed to eliminate waste by scrubbing out water, mist, distillate etc., and by utilizing Linear Deflection, Contraction and Expansion (Law of Refrigeration), Screening or Wire Drawing, Capillary Attraction, Jetting, and Wiping, to reduce the moisture content.

Serious damage often occurs to drilling engines or pumps when they are called upon to handle large slugs of water, or condensate, which, unlike steam or air, cannot be compressed. This water, which condenses or accumulates in long steam lines, or is "pulled over" by suddenly opening the throttle, is continuously removed by the W-K-M steam scrubber, illustrated directly above, and only clean, dry, steam is delivered from the outlet side. Likewise, the W-K-M exhaust steam scrubber removes oil, curd and other impurities which are damaging to preheaters and boilers. Where water is at a premium, the water scrubbed from exhaust steam is collected and used over again.

When handling gas from wells, a W-K-M gas scrubber removes valuable distillate otherwise lost to the atmosphere. This distillate is scrubbed from the gas, and is discharged through a trap to suitable collecting facilities. After being scrubbed of all impurities, clean dry gas is then available.





Feature of the first Mixing Equipment Company of Rochester, N. Y. exhibit at the International Petroleum Exposition is cutaway models of all styles of Lightning Mixers, including side entering mixers, nozzle mounting tripods, portable mixers, laboratory models, etc.

Directly above are two illustrations relating to the Mixing Equipment Company's display. The blue print at top illustrates features of the basic bearing member, the heart of the mixer. No. 1 is the shaft; (2) end plug; (3) set screw; (4) packing; (5) bearing guide pin; (6) sleeve bearing; (7) compression sleeve; and (8) flanged bearing member. At the right side of this drawing, (9) is a grease cup; (10) bearing guide pin; (11) sleeve bearing; (12) lock nut; (13) packing; (14) packing gland; (15) compression cap; (16) set screw; (17) thrust collar; (18) lantern ring; and (19) connecting pipe.

The bearing member consists of a hollow structure carrying two bearings in line, protected by stuffing boxes at each end. Bearings are of colloidal leaded bronze. The bearings slide in the bearing member but are prevented from rotating with the shaft by dowel pins which ride in keyways cut in the upper side of the bearing.

Below the blue print is a picture of one model of the mixer. It comprises a propeller shaft, bearing member, Allis-Chalmers matched tension Tex Rope Vee-Belt Drive, welded steel support bracket, cylindrical type, and extra rear bearing (ball, radial and thrust, Norma Hoffman Cartridge Type). Motor is mounted on pivoted steel platform, actuated by a riser bolt, permitting maximum adjustment for belt tension or replacement. Belts are protected by sheet metal guard completely shielding pulley, sheave and belts. A support pipe leg and flange footing is supplied.

Oceco type B vent units which are being exhibited at the Oil Show by the Oceco division of The Johnston and Jennings Co. are made up of the flame arrestor in combination with a vent valve and flame snuffer in 2, 3, 4, 6, 8 and 10 in. sizes.

The purpose of the flame arrestor is to prevent fire or explosions from passing back through the vent into the interior of the tank. These arrestors are fitted with a flame arrestor element which permits the passage of vapors or air as the tank breathes in and out but will stop fire or explosion.

The purpose of the vent valve is to prevent free circulation of air inside of the tank and thus to keep evaporation losses under control. The vent valves are fitted with separate pressure and vacuum relief valves set to relieve excessive pressure or vacuum.

The flame snuffer is for use in the event the vapors escaping from the tank should become ignited, inasmuch as it is not desirable to let such vapors burn indefinitely. The snuffer is operated by pulling the snuffer chain from the ground thus closing the vent opening for a moment or two and thus snuffing out the flame. The Oceco 6 in. vent unit is illustrated in the center of this page with inspection covers open, and flame arrestor element (in red) partially withdrawn.

The housings of both the Oceco valve and flame arrestor are made of semi-steel castings, have a melting point of about 2,300 deg. F and this material will retain about 80 to 90 percent of its original strength at 1000 deg. F. The internal working parts, including the flame arrestor element and the valves, valve seats and guides in the vent valves are made of aluminum to provide all-around corosion resistance.

The flame arrestor element is made up of alternate flat and corrugated aluminum sheets forming a multiplicity of separate passages. Passages through the Oceco flame arrestor element are vertical and straight. There are no obstructions, angles or turns. The straight through passages offer a minimum of resistance to vapors passing out and air passing in, as the tank breathes.

Both the flame arrestor and vent valve are fitted with hinged inspection covers held in place by a single clamping hand wheel.

Diagramatically illustrated below is a Dresser (style 38) steel coupling for plain end standard steel pipe from 3/4 in. inside diameter to 24 in. outside diameter. It provides a flexible connection and consists of standard parts which are assembled with a wrench compressing the rubber-compound gasket tightly around the pipe. Expansion, vibration and pipe deflections are absorbed.

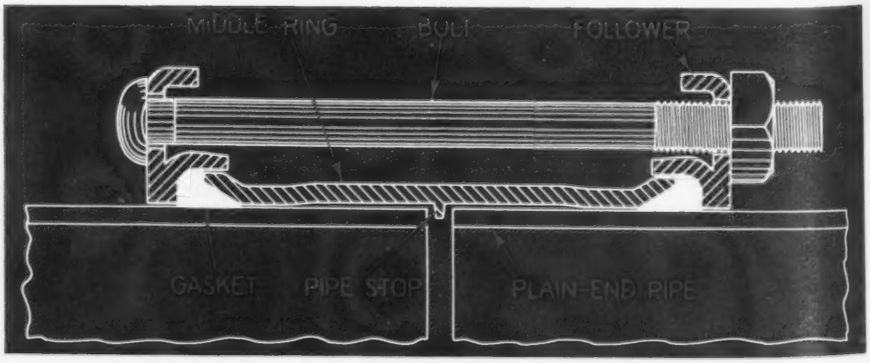
Featured in the exhibit of The Lincoln Electric Company, at the 11th Annual International Petroleum Exposition at Tulsa are the latest models of stationary and portable "Shield-Arc S. A. E." arc welders embodying self-indicating dual continuous control, which makes it possible to obtain a welding arc of proper type and intensity for any application of arc welding in the wind, tacking, overhead position, etc.

The left hand control in the inset on each of the graphs at top right, is the "job selector" by which the operator can vary the open-circuit voltage and thereby tune in any desired type of arc to suit the particular application. This job selector is self-indicating and continuous in operation.

The current control, shown on the right of this inset, permits the operator to select any desired number of amperes to suit the size of electrode and the type of joint, or material, being welded. This control, also, is self indicating.

By varying the job selector, the open-circuit voltage of the machine is changed, producing any desired number of volt-ampere curves of the same type or slope such as shown in the upper right hand chart.

Now, when the volume or current control is varied, leaving the job selector or voltage



control stationary, the welding current is changed, producing any desired type or slope of volt-ampere curves such as shown in the lower left hand chart.

From this it is evident that an indeterminate number of volt-ampere curves can be produced for each open-circuit voltage adjustment.

Operator can choose a volt-ampere setting which can be anywhere or of any slope between the lowest open-circuit voltage (Curve 1, in the lower left hand chart) and minimum current and that of the highest open-circuit voltage and maximum current (Curve 2).

Reference to the lower right hand chart will show why a welder using a machine with adequate control, can obtain any characteristic he wants. Select any welding current and its corresponding arc voltage such as the point "A". Through that point, any number of volt-ampere curves can be produced, varying in slope as shown from the gradually sloping curve (indicated by Curve 3), to the steep Curve 4. This effect is produced in actual operation of the machine by varying the open-circuit voltage while regulating for the same welding current.

Now, suppose the welder were to shorten the arc, thus decreasing the arc voltage to the values indicated at "B".

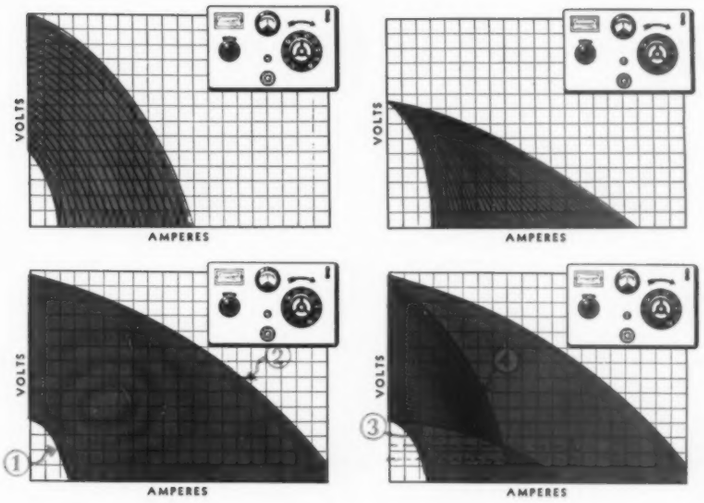
It is clearly evident that the shortening of the arc in this way results in a material increase in the welding amperes when set for Curve 3.

On the other hand, when set for Curve 4, a shortening or lengthening of the arc causes little change in the welding current.

When welding is being done out in the wind the welder must have an arc that will not blow out. In such applications, a steep volt-ampere curve gives an arc whose current remains almost constant as the arc is lengthened. This means that the type of arc produced by this curve will resist being blown out.

For making a bell-hole joint in overhead position on a pipe line a short, forceful arc is essential. Such an arc is provided by a volt-ampere curve of more gradual slope which gives an arc whose current increases as the welder shortens the gap, therefore holding energy in the arc at a constant. This constant energy with a short arc insures sufficient heat energy for proper fusion obviously necessary for overhead welding.

Century Electric Co. is exhibiting at Tulsa high torque, high slip, splash proof motors



one of which is illustrated at the bottom left hand side of this page.

1) The motor has a high starting torque.
2) It has high slip, which means the motor speed pulls down against the impact of peak loads as found in reciprocating pump operation.

When the load is light on the pump stroke, the motor speeds up and stores useful energy in the flywheel action of its own armature and the pumping unit counterweight. The motor slows down against the maximum power peaks, cushioning the impact, and using energy stored in armature and counterweight.

The high slip motor requires less starting current, which reduces the power inrush both at starting and at each peak load. This causes smaller current variations and permits more motors of a given horsepower for the same line capacity.

The splash proof housing resists rain, snow, and ice.

Allis-Chalmers Mfg. Company is featuring at the Tulsa show a new distribution transformer illustrated at right below. Cadmium plated 3-way terminals allow leads to enter the terminal from any one of three directions. The heavy cadmium plating reduces corrosion and minimizes electrolytic action when used with either aluminum or copper conductors.

Installation can be made with ordinary tools carried by a lineman, and because of the construction of the 3-way terminal, the tightening tool always travels in an up and down direction, preventing any accidental short circuit across the secondary terminals.

Tanks are of durable steel construction, tested under pressure to prevent oil leakage. Side walls extend below the bottom to give protection in handling and to prevent rusting. The tank surface is borderized and then covered with three coats of baked-on paint.

Double conductor insulation is used to give added di-electric strength and greater physical separation of turns. Small conductors have a coating of flexible enamel plus spiral paper wrapping. Large conductors have a spiral paper wrapping with an added covering of cotton tape.

Bushings are coordinated and made of wet process porcelain with extra wall thickness. Clamps hold the bushings tight against lacquered gaskets, insuring oil tightness.

High voltage bushings have curved shanks to prevent internal flashover and are protected by an overhanging pocket. Both high and low voltage bushings have been designed to eliminate radio interference.

The Tulsa exhibit of the International Derrick and Equipment Company features a twin crank pumper equipped with full circle W-O wheel-type cranks and a needle-roller bearing type rein hanger. A needle-roller type bearing being actuated in the true oscillating motion of a center iron bearing and having a portion of the bearing housing cut away, revealing the action of the rollers is being demonstrated

The new Ideco 85 streamlined reducer mounted on a cast sub-base with cast prime mover rail which permit a greater range of adjustment and adapts itself readily to any type of prime mover is included in the exhibit. This unit has a new clamp type upper pitman bearing and a safety cut-out switch mounted on the walking beam.

Foreign Oil Legion

Jan van Seventer, marine superintendent of the Asiatic Petroleum Corporation, pictured on board the ss. VULCANIA as he sailed with his wife from New York on April 6 for a vacation trip through Italy and France.

Arthur H. Elliot, recently appointed London representative of the Standard Vacuum Oil Company, as he sailed from New York aboard the ss. MANHATTAN on April 20 to begin his duties in England.

JOHN FRANKLIN DODGE, professor of Petroleum Engineering at the University of Southern California, gave a talk on the oilfields of India, Burma and the East Indies at the regular monthly meeting of the Los Angeles chapter of the Nomads held April 10th. He discussed transportation routes relative to the development of the various fields in this great region. Over eighty members and guests were in attendance and among those from foreign fields were the following: E. M. Archibald, Trinidad Petroleum Development Company, F. W. Van Bilderbeek, B. P. M., B. Bongers, U. B. O. T., Erno Bonebakker, B. P. M., Chas. D. Hauenstein, I. P. C. (Iraq Pet. Co.), Karl B. Jauman, Attock Oil Company, Clarence Ochs, Ecuadorian Oilfields, Ltd., Jesse H. L. Scheppers, N. K. P. M., John A. Thornton, B. P. M. and E. Le M. Trafford, B. P. M.

John F. Conway, Standard Oil Company of N. J., bound for Italy on a business trip of indefinite length. Mrs. Conway is seeing her husband off as he sails on the ss. VULCANIA from New York on April 6.

DONALDSON B. THORBURN, assistant sales promotion and advertising manager of Shell Oil Company, Incorporated, recently announced his resignation to become effective May 1, after which he will leave for an extended trip in Latin America to cover motion picture and writing assignments.

Accompanying him will be his wife, Lois Long, nationally known writer and head of the fashion department of THE NEW YORKER magazine. The couple's itinerary includes Panama, Ecuador and Peru, after which they will journey down the Amazon River to Belem, returning to New York in the Fall.

The purpose of the trip, the Thorburns said, is to accumulate material for presentation in factual and fictional form. They plan further studies of the Latin American countries in future.

Before joining Shell's advertising department, Thorburn was bank editor of THE WALL STREET JOURNAL in New York, and previously city editor of the JOURNAL'S Pacific Coast Edition. His early writing experience was with the San Francisco CALL-BULLETIN.

Otto A. Swickert, Managing Director of Petrole S. A. Bulgare, subsidiary of Socony-Vacuum Oil Company, on the pier in New York waiting to pass customs formalities. Mr. Swickert arrived, April 15 aboard the ss. MANHATTAN after spending four years in Bulgaria. He anticipates an extended vacation in the United States.

NELSON and LAURANCE ROCKEFELLER, accompanied by their wives sailed from New York, Friday, April 5th aboard the steamship *Santa Paula* for Venezuela. Mr. Rockefeller has expressed his interest in the public health and social welfare work being performed by the government in Venezuela and hopes to have an opportunity to become acquainted with recent developments in this field. He also had somewhat indefinite plans for constructing a small hotel in Caracas. Mr. Nelson Rockefeller is president of Rockefeller Center, Inc.

George Anderson, California Texas Oil Company, on the deck of the ss. CONTE di SAVOIA on his way to Europe where he will remain for the next three years. Mr. Anderson is accompanied by Miss Virginia Peace who saw him off when he left New York.

MR. VAN BERGEN, formerly with the Gulf Oil Corporation, has recently joined the Alliance Oil Corporation, according to an announcement made by L. C. QUACKENBUSH, president of Alliance, Mr. Van Bergen was born in Sumatra, Netherland India and graduated from Cambridge University where he majored in geology and chemistry. In the Far East he represented the British American Tobacco Company until he joined the Gulf organization with whom he remained until his connection with Alliance was formed on April 1st.

JOHN DOMERCO, petroleum engineer employed by the California Arabian Standard Oil Company, recently arrived in Southern California on a vacation and to give some time to study of operations in the state.

R. H. MCPEAKE, Export Sales Engineer, stationed at Port-of-Spain, Trinidad, for the Oil Well Supply Company, Export Division, has returned to New York on leave, and will attend the International Petroleum Exposition at Tulsa, May 18th to 25th. Following the Exposition, Mr. McPeake will make a number of inspection trips through the Midwest before returning to Trinidad.

MRS. HOBART LAMAR left Los Angeles early in April for New Zealand to join her husband who is employed by the New Zealand Petroleum Company. She remained in California for a long visit following the departure of her husband several months ago.

Dr. Henry Butler Allen (left), secretary and director of The Franklin Institute, presents Robert H. Colley, president of The Atlantic Refining Company, with a Franklin Institute citation for his company's pioneer work in many fields relating to the refining, transportation and marketing of petroleum products. The presentation was made at a dinner given (April 29) by The Franklin Institute in honor of The Atlantic Refining Company on the seventieth anniversary of its founding.

COLIN REITH, connected with Bahrein Petroleum, Bahrein Island, Persian Gulf, who has been convalescing at Mayo Clinic, arrived in Los Angeles April 15, to complete his vacation and business trip. He plans to spend some time looking into field operations in California before returning to his post of duty.

Egon Alzner of the Astra Romana (Shell subsidiary in Roumania) sailing from New York with his wife on board the ss. CONTE de SAVOIA for an indefinite stay in Europe.

FOREIGN visitors to the International Petroleum Exposition at Tulsa will have an opportunity to inspect a modern and complete plant for the manufacture of drilling rigs, servicing hoists and pipeline construction equipment. The Cardwell Manufacturing Company has arranged for a series of air trips from Tulsa to their factory in Wichita on which foreign visitors to the fair will be the guests of the company. The trip will take about 45 minutes in a Cessna T50, capable of 191 m.p.h. The inspection of the Cardwell plant will take approximately two hours, after which visitors will be flown back to Tulsa. Although Cardwell will have a exhibit at the oil show, H. H. Cardwell, president of the company, has long been anxious to afford interested Exposition visitors a more comprehensive display of equipment at the factory. This has now become possible by avoiding the seven hour one-way trip via automobile or train.

J. L. ANDREWS, holding a prominent post in the field operations department of the Sarawak Oilfields, Ltd., at Miri, Sarawak, left Los Angeles late in April for his post after a vacation in the States and many tours into the various oilfields where he looked into new methods. His family accompanied him on his vacation.

A. N. McKenzie who left Los Angeles on April 2 via Pan American Airlines for Lima, Peru where he will act as vice-president and general manager of Ganzo Azul, Ltd. Ganzo Azul is the company that discovered commercial production in Eastern Peru, not far from the headwaters of the Amazon system. Mr. Mackenzie was formerly vice-president and general manager of the Venezuela Petroleum Company with headquarters in Caracas where he had stayed for 13 years.

WORLD OIL PR

All figures furnished direct to WORLD PETROLEUM by governments, except where otherwise spec... Figures in U...

U. S. BARRELS

	Apr. 1939	May 1939	June 1939	July 1939	Aug. 1939	Sept. 1939	Oct. 1939	Nov. 1939	Dec. 1939	Jan. 1940	Feb. 1940	Preliminary Figures March 1940
United States	105,510,000	110,541,000	104,607,000	110,937,000	80,865,000	108,168,000	114,197,800	111,887,000	114,808,500	113,140,700	108,668,800	119,360,00...
Soviet Union[4]	18,100,000	18,500,000	18,700,000	18,200,000	18,100,000	18,000,000	18,406,932[1]	17,813,160[1]	18,406,932[1]	18,406,932[1]	17,251,723[1]	18,454,7...
Venezuela	16,980,646	17,676,580	16,430,625	18,015,182	18,743,714	18,652,354	19,516,845	16,681,881	16,050,535	14,798,667	14,380,134	17,066,1...
Iran[5]	7,237,755	6,801,192	6,341,652	6,637,503[1]	6,637,503[1]	6,423,390[1]	6,637,503[1]	6,423,390[1]	6,637,503[1]	6,637,503[1]	6,227,895[1]	6,745,87...
Netherland India: Sumatra	3,401,503	3,602,543	3,498,094	3,557,020	3,550,123	3,502,437	3,600,371	3,427,490	3,629,655	3,472,786	3,149,536	3,538,96...
Borneo	1,113,474	1,173,509	1,154,341	1,156,942	1,111,810	865,693	995,207	1,068,349	1,086,713	1,093,743	1,062,210	1,103,22...
Java[2]	509,355	530,273	514,565	565,181	559,096	511,355	556,658	549,926	633,136	561,064	507,207	554,59...
Molucca[8]	82,914	89,975	77,305	73,962	71,767	68,065	64,292	62,340	60,550	59,215	62,340	71,10...
Roumania	3,743,881	3,840,413	3,684,366	3,902,208	3,945,625	3,795,308	3,842,567	3,743,041	3,842,154	3,786,908	3,595,888	3,870,15...
Mexico[15]	3,140,120	2,945,000	3,100,000	3,245,000	3,700,000[1]	4,050,000	4,500,000	3,700,000	3,500,000	3,348,682	3,050,000	3,506,22...
Iraq	2,608,235	2,663,827	2,721,992	2,807,402	2,615,129[1]	2,530,770[1]	2,615,129[1]	2,530,770[1]	2,615,129[1]	2,615,129[1]	2,461,723[1]	2,666,71...
Colombia	1,826,928	1,899,735	1,851,716	1,798,271	1,950,966	1,894,941	1,860,620	1,918,891	1,871,594	1,924,655	1,767,840[1]	1,895,94...
Trinidad	1,569,298	1,645,040	1,575,321	1,620,564	1,636,645[1]	1,583,850[1]	1,636,645[1]	1,583,850[1]	1,636,645[1]	1,636,645[1]	1,529,808[1]	1,633,42...
Argentine	1,507,159	1,559,568	1,533,250	1,508,738	1,495,806	1,542,755	1,632,997	1,621,927	1,691,123	1,751,910	1,797,072	1,625,98...
Peru[3]	1,151,193	1,078,426	1,051,265	1,100,000[1]	1,100,000[1]	1,116,810[1]	1,154,037[1]	1,116,810[1]	1,154,037[1]	1,154,037[1]	1,071,869[1]	1,139,93...
Bahrein[6]	629,336	626,009	628,812	671,892	698,714	647,595	571,673	563,985	645,575[1]	645,575[1]	603,722[1]	643,08...
Burma[7]	581,633	696,936	665 942	650,828	696,317	685,756	647,311[1]	626,430[1]	647,311[1]	647,311[1]	609,232[1]	665,13...
Canada[2]	559,368	713,947	821,308	899,169	795,844	720,866	816,257	731,209	502,920	486,859	639,624[1]	683,73...
Brunei[2]	466,328	486,815	464,271	490,318	488,777[1]	473,010[1]	488,777[1]	473,010[1]	488,777[1]	488,777[1]	456,576[1]	487,66...
Great Germany: Old Reich[16]	373,126	407,028	373,510	391,098	381,114[1]	368,820[1]	381,114[1]	368,820[1]	381,114[1]	381,114[1]	360,383[1]	386,50...
Ostmark[16]	54,375	64,840	74,726	85,131	58,869[1]	56,970[1]	58,869[1]	56,970[1]	58,869[1]	58,869[1]	57,072[1]	61,72...
Slovakia and Moravia	9,000	10,000	9,000	11,000	11,000[1]	9,810[1]	10,137[1]	9,810[1]	10,137[1]	10,137[1]	9,454[1]	10,10...
Poland	326,436[1]	333,800[1]	318,000[1]	330,000[1]	330,000[1]	320,370[1]	331,049[1]	320,370[1]	331,049[1]	331,049[1]	310,155[1]	331,66...
Japan[16]	218,612	221,129	221,128	222,072	210,105	222,513	223,016	224,494	223,960[A]	225,308[1]	210,801[1]	224,06...
British India[11]	105,477	127,700	137,070	175,932	200,036	212,322	188,666[1]	182,580[1]	188,666[1]	188,666[1]	171,303[1]	179,08...
Ecuador	175,896	193,353	193,710	206,868	204,115	193,720	193,382	196,808	205,138	204,509	188,024	211,61...
Saudi Arabia	234,742	281,325	302,932	342,558	429,104	538,136	512,590	313,757	437,020	491,663	323,416	406,20...
Sarawak[12]	110,982	112,572	104,224	107,961	112,716[1]	109,080[1]	112,716[1]	109,080[1]	112,716[1]	112,716[1]	104,951[1]	112,28...
Egypt[13]	328,376	368,081	425,231	436,519	440,678	362,880	420,519	434,174	385,795[1]	385,733[1]	367,024[1]	396,83...
Italian Empire: Albania[16]	244,576	81,839	79,931	140,025	89,000[1]	114,540[1]	118,358[1]	114,540[1]	118,358[1]	118,358[1]	112,230[1]	123,41...
Italy	7,792	7,253	7,181	6,843	7,600[1]	7,736[1]	7,750[1]	7,500[1]	7,750[1]	7,750[1]	7,250[1]	7,65...
France	41,000[1]	42,000[1]	41,000[1]	42,000[1]	42,000[1]	42,653[1]	42,470[1]	41,160[1]	42,532[1]	42,532[1]	39,817[1]	42,43...
Hungary	67,000[1]	70,000[1]	67,000[1]	70,000[1]	70,000[1]	65,210[1]	65,317[1]	63,210[1]	65,317[1]	65,317[1]	62,350[1]	67,58...
Bolovia	8,500[1]	8,700[1]	8,500[1]	8,700[1]	8,700[1]	7,893[1]	8,556[1]	8,280[1]	8,556[1]	8,556[1]	7,975[1]	8,58...
Other Countries[17]	48,000	50,000	48,000	50,700	50,700	50,000	49,073	47,490	49,073	49,073	45,849[1]	49,78...
WORLD TOTAL	173,073,016	179,405,408	171,832,968	180,464,587	151,408,573	177,915,608	186,465,203	179,022,502	182,534,839	179,338,448	171,271,253	188,531,83...

[A] Estimated official sources.
[1] Estimated W. P.
[2] Includes natural gasoline (naphtha) production.
[3] International Petroleum Company and Lobitos Oilfields, Ltd. figures combined.
[4] Russian Saghalin included with U.S.S.R.
[5] Anglo-Iranian Oil Company, Ltd., figures revised —fuel oil returned to the ground has been deducted.
[6] Bahrein Petroleum Company, Ltd., figures.
[7] Does not include Assam or Punjab, which are listed together under British India.
[8] British Malayan Petroleum Company, Ltd., figures.
[9] Includes Madura.
[*] Includes all other Netherland India.

Daily Averages in Barrels

	Jan.—March 1940	Jan.—March 1939
United States	3,749,115	3,363,700
Soviet Union	594,653	583,333
Venezuela	508,186	522,613
Iran	215,499	204,154
Netherland India: Sumatra	111,662	108,753
Borneo	35,816	36,773
Java	17,833	18,212
Ceram	2,118	1,939
Roumania	123,660	128,803
Mexico	108,845	83,866
Iraq	85,094	78,697
Colombia	61,411	57,366
Trinidad	52,745	53,137
Argentine	56,867	50,214
Peru	36,987	39,614
Bahrein	20,794	21,306
Burma	21,117	19,147
Canada	19,892	14,184
Brunei	15,747	15,945
Great Germany: Old Reich	12,395	11,797
Ostmark	1,952	1,373
Slovakia and Moravia	326	327
Poland	10,690	10,633
Japan	7,254	7,398
British India	5,923	7,810
Ecuador	6,638	6,101
Saudi Arabia	15,618	6,019
Sarawak	3,625	3,725
Egypt	12,632	10,449
Italian Empire: Albania	3,890	3,250
Italy	248	265
France	1,371	1,377
Hungary	2,145	1,844
Bolivia	276	272
Other Countries	1,590	1,500
WORLD TOTAL	5,924,632	5,473,951

Official Crude Oil Production Figures for 1933 to 1939 (Revised) in Barrels

	1939	1938	1937	1936	1935	1934	1933
United States	1,264,256,000	1,214,355,000	1,279,160,000	1,098,516,000	996,596,000	908,065,000	905,656,000
Soviet Union	216,727,024	206,192,000	201,856,661	199,635,921	184,008,033	175,635,783	155,596,429
Venezuela	205,783,585	188,429,050	187,675,477	155,270,840	148,809,057	136,098,681	117,113,940
Iran	78,151,332	78,320,840	78,109,001	62,977,950	57,520,488	57,902,092	54,440,075
Netherland India: Sumatra	41,557,020	34,538,128	33,451,511	30,469,428	28,004,595	26,336,011	22,345,172
Borneo	13,125,425	12,812,383	12,960,072	13,068,910	13,529,185	14,335,543	15,003,175
Java	6,568,660	6,955,283	7,152,931	3,618,293	3,462,440	3,778,920	3,600,816
Molucca	836,144	607,622	537,436	375,823	311,872	273,698	285,335
Roumania	45,931,846	48,366,000	52,395,725	63,532,846	61,270,072	61,849,306	53,919,700
Mexico	39,428,141	38,505,824	46,455,687	41,027,915	40,240,563	38,171,946	34,000,830
Iraq	30,791,132	32,404,000	30,603,660	29,913,150	27,410,983	7,639,849	1,094,915
Colombia	22,036,613	21,581,588	20,297,543	18,756,110	17,597,655	17,337,900	13,156,126
Trinidad	19,270,256	17,736,176	15,502,989	13,237,030	11,671,224	10,894,363	9,561,353
Argentine	18,613,167	17,076,237	16,354,717	15,457,960	14,297,025	14,021,901	13,690,556
Peru	13,587,906	15,908,279	17,459,112	17,593,069	17,056,555	16,314,381	13,257,318
Bahrein	7,601,167	8,297,998	7,762,264	4,644,635	1,264,807	285,072	31,377
Burma	7,621,707	7,499,498	7,847,553	7,587,718	7,181,113	7,278,859	7,114,311
Canada	7,837,503	6,965,457	2,996,033	1,507,931	1,447,204	1,410,895	1,145,333
Brunei	5,755,164	5,387,214	4,397,038	3,296,938	3,302,905	2,705,350	2,035,656
Great Germany: Old Reich	4,487,491	3,850,044	3,148,300	3,076,858	2,967,438	2,204,402	1,656,602
Ostmark	693,247	370,038	221,266	50,092	44,347	27,965	5,765
Slovakia and Moravia	119,380	132,005	123,474	126,603	136,580	177,797	121,695
Poland	3,898,044	3,828,438	3,799,862	3,869,575	3,901,881	4,011,336	4,174,079
Japan	2,652,930	2,511,184	2,487,841	2,403,072	2,294,878	1,872,837	1,504,612
British India	2,221,406	2,330,209	2,161,653	1,978,329	2,037,810	1,921,863	1,628,803
Ecuador	2,312,118	2,257,278	2,161,436	1,942,467	1,731,785	1,636,619	1,619,902
Saudi Arabia	3,933,904	495,135	64,968	19,777	Nil	Nil	Nil
Sarawak	1,327,327	1,624,882	1,655,565	1,547,882	1,776,593	1,942,591	2,206,815
Egypt	4,541,746	1,561,231	1,163,267	1,262,666	1,255,151	1,527,252	1,653,535
Italian Empire: Albania	1,393,727	437,597	380,292	219,693	41,218	17,500	11,437
Italy	91,330	106,083	112,700	129,653	128,615	162,449	213,534
France	500,815	516,240	507,067	534,063	529,664	700,000	786,366
Hungary	769,092	330,829	13,910	100	Nil	Nil	Nil
Bolivia	100,885	106,620	123,123	104,746	163,295	157,875	111,973
Other Countries	578,036	243,000	70,000	37,100	32,300	64,000	54,100
WORLD TOTAL	2,030,101,270	1,982,639,390	2,041,170,134	1,797,791,150	1,652,023,331	1,516,760,036	1,438,797,443

PRODUCTION

Figures in U. S. barrels of 42 gal.—Conversion ratios used are weighted averages for individual countries

METRIC TONS

	Apr. 1939	May 1939	June 1939	July 1939	Aug. 1939	Sept. 1939	Oct. 1939	Nov. 1939	Dec. 1939	Jan. 1940	Feb. 1940	Preliminary Figures March 1940
United States	14,275,470	14,956,000	14,153,000	15,009,700	10,941,000	14,635,096	15,450,953	15,138,276	15,533,757	15,307,901	14,702,854	16,149,370
Soviet Union[4]	2,480,000	2,536,000	2,590,000	2,500,000	2,480,000	2,300,000	2,508,024[1]	2,427,120[1]	2,508,024[1]	2,508,024[1]	2,360,194[1]	2,531,522
Venezuela	2,521,254	2,624,585	2,439,598	2,674,860	2,783,031	2,769,466	2,897,824	2,476,894	2,383,153	2,197,278	2,135,135	2,560,135
Iran[5]	960,120	902,208	841,248	880,493[1]	880,493[1]	852,090[1]	880,493[1]	852,090[1]	880,493[1]	880,493[1]	826,152[1]	894,753
Netherland India: Sumatra	435,476	461,214	447,842	455,386	454,503	448,398	460,936	438,803	464,685	444,602	403,218	453,073
Borneo	142,552	150,238	147,784	148,117	142,339	110,830	127,411	136,775	139,126	140,026	135,989	141,236
Java[5]	65,210	67,888	65,877	72,357	71,578	65,466	71,266	70,404	81,057	71,830	64,935	70,990
Molucca[*]	10,615	11,519	9,897	9,469	9,188	8,842	8,231	7,981	7,752	7,581	7,981	9,114
Roumania	507,645	520,734	499,575	529,113	535,000	514,618	521,026	507,531	520,970	513,479	487,578	524,768
Mexico[18]	461,104	432,452	455,212	476,505	543,316	594,713	660,973	543,318	513,950	492,094	447,870	514,910
Iraq	348,648	356,079	363,854	375,271	349,556[1]	338,280[1]	349,556[1]	338,280[1]	349,556[1]	349,556[1]	330,034[1]	356,531
Colombia	254,802	264,956	258,258	247,017	272,101	264,287	257,920	267,627	260,524	268,431	246,094[1]	263,872
Trinidad	220,717	231,370	221,564	227,927	230,206[1]	222,780[1]	230,206[1]	222,780[1]	230,206[1]	230,206[1]	215,151[1]	229,710
Argentine	214,695	222,160	218,411	214,919	213,077	219,765	232,620	231,043	240,900	249,559	255,993	231,601
Peru[5]	151,973	142,367	138,782	146,000[1]	146,000[1]	147,810[1]	152,737[1]	147,810[1]	152,737[1]	152,737[1]	141,810[1]	150,784
Bahrein[5]	85,920	85,353	85,665	91,551	95,348	87,030	78,012	76,963	87,885[1]	87,885[1]	82,186[1]	87,544
Burma[5]	80,336	96,261	91,980	89,893	96,176	94,717	89,404[1]	86,520[1]	89,404[1]	89,404[1]	84,129[1]	91,853
Canada[5]	71,184	90,856	104,518	114,427	101,278	91,736	103,875	93,052	64,001	61,957	81,374[1]	98,735
Brunei[5]	62,209	64,943	61,935	65,410	65,193[1]	63,090[1]	65,193[1]	63,090[1]	65,193[1]	65,193[1]	60,900[1]	65,038
Great Germany: Old Reich[14]	53,357	58,205	53,412	55,927	58,300[1]	53,190[1]	54,963[1]	53,190[1]	54,963[1]	54,963[1]	51,997[1]	55,800
Ostmark[15]	8,106	9,666	11,289	12,691	13,000[1]	9,030[1]	9,331[1]	9,030[1]	9,331[1]	9,331[1]	9,048[1]	9,827
Slovakia and Moravia	1,400	1,500	1,400	1,600	1,600[1]	1,550[1]	1,519[1]	1,470[1]	1,519[1]	1,519[1]	1,421[1]	1,519
Poland	44,000[1]	45,000[1]	41,000[1]	45,000[1]	45,000[1]	42,960[1]	44,392[1]	42,960[1]	44,392[1]	44,392[1]	41,644[1]	44,516
Japan[3]	31,095	31,455	31,454	31,544	31,721	31,651	31,723	31,933	31,857[A]	32,178[1]	30,131[1]	32,023
British India[11]	14,568	17,638	18,932	24,300	27,629	29,326	26,040[1]	25,200[1]	26,040[1]	26,040[1]	23,635[1]	24,707
Ecuador	23,190	25,491	25,539	27,272	26,910	25,540	25,495	25,947	27,045	26,962	24,788	27,898
Saudi Arabia	31,799	38,110	41,037	46,404	58,129	72,899	72,899	42,503	59,201	66,604	43,812	82,120
Sarawak[13]	14,183	14,386	13,329	13,797	14,539[1]	14,070[1]	14,539[1]	14,070[1]	14,539[1]	14,539[1]	13,543[1]	14,415
Egypt[12]	46,897	52,568	60,730	62,342	62,936	51,810	60,057	62,150	55,087[1]	55,335[1]	52,432[1]	56,699
Italian Empire: Albania[16]	36,657	12,266	11,980	20,987	13,000[1]	17,100[1]	17,670[1]	17,100[1]	17,670[1]	17,670[1]	16,762[1]	18,415
Italy	968	901	892	850	950[1]	961[1]	961[1]	930[1]	961[1]	961[1]	899[1]	930
France	5,700[1]	6,000[1]	5,700[1]	6,000[1]	6,000[1]	5,760[1]	5,952[1]	5,760[1]	5,952[1]	5,952[1]	5,568[1]	5,952
Hungary	9,000[1]	9,500[1]	9,000[1]	9,500[1]	9,500[1]	8,490[1]	8,773[1]	8,490[1]	8,773[1]	8,773[1]	8,381[1]	9,052
Bolivia	1,000[1]	1,000[1]	1,000[1]	1,000[1]	1,000[1]	960[1]	992[1]	960[1]	992[1]	992[1]	928[1]	992
Other Countries,[17]	6,700[1]	7,000[1]	6,760[1]	7,100[1]	7,100[1]	7,000[1]	6,975[1]	6,750[1]	6,975[1]	6,975[1]	6,525[1]	7,006
WORLD TOTAL	23,678,550	24,547,815	23,528,394	24,694,749	20,786,697	24,201,311	25,528,941	24,474,800	24,938,670	24,491,422	23,401,091	25,817,409

[3] Japanese Saghalin, Taiwan (Formosa) and Hokkaido included with Japan.
[5] Excluding Burma.
[13] Sarawak Oilfields, Ltd., figures.
[A] Estimated Official Sources
[12] Anglo-Egyptian Oilfields, Ltd., figures.
[14] Prussia, Thuringia and Baden.
[15] Formerly known as Austria.
[16] Italian imports of Albanian crude oil.
[*] Includes all other Netherland India.
[17] Estimate representing Morocco, Cuba, New Zealand, Barbados, Greece, Algeria, Yugoslavia, Australia, Great Britain, Kuweit and China.
[18] Official Figures—Petroleos Mexicanos.

Daily Averages in Metric Tons

	Jan.—March 1940	1939
United States	507,254	455,107
Soviet Union	81,315	80,011
Venezuela	75,742	77,368
Iran	28,586	27,082
Netherland India: Sumatra	14,294	13,923
Borneo	4,585	4,784
Java	2,283	2,331
Ceram	271	251
Roumania	16,767	17,464
Mexico	15,987	12,363
Iraq	11,385	10,519
Colombia	8,553	8,000
Trinidad	7,418	7,475
Argentine	8,100	7,148
Peru	4,893	5,248
Bahrein	2,830	2,902
Burma	2,916	2,644
Canada	2,660	1,805
Brunei	2,100	2,128
Great Germany: Old Reich	1,788	1,687
Ostmark	309	204
Slovakia and Moravia	49	50
Poland	1,434	1,424
Japan	1,036	1,052
British India	817	1,078
Ecuador	875	826
Saudi Arabia	2,115	815
Sarawak	467	487
Egypt	1,807	1,491
Italian Empire: Albania	580	487
Italy	30	33
France	192	193
Hungary	287	248
Bolivia	32	33
Other Countries	225	222
WORLD TOTAL	809,709	748,954

Official Crude Oil Production Figures for 1933 to 1939 (Revised) in Metric Tons

	1939	1938	1937	1936	1935	1934	1933
United States	171,053,443	164,346,325	172,822,797	148,707,864	134,912,143	122,913,903	122,601,191
Soviet Union	29,530,168	28,859,000	27,867,025‡	27,384,900	25,241,100	24,092,700	21,330,100
Venezuela	30,533,706	27,845,286	27,733,926	22,945,299	21,990,373	20,112,115	17,293,193
Iran	10,367,112	10,358,495	10,330,480	8,329,289	7,607,500	7,657,970	7,200,093
Netherland India: Sumatra	5,320,320	4,662,836	4,490,137	4,114,710	3,759,006	3,535,035	2,999,352
Borneo	1,680,377	1,719,783	1,739,607	1,773,545	1,815,998	1,924,234	2,013,849
Java	840,950	933,595	960,125	499,097	464,757	51(320	483,331
Molucca	107,047	81,560	72,139	50,446	41,862	36 738	38,300
Roumania	6,228,047	6,603,000	7,153,000	8,704,000	8,394,000	8,473,355	7,387,000
Mexico	5,794,215	5,716,423	6,896,657	6,090,842	5,973,955	5,666,857	5,049,109
Iraq	4,115,845	4,345,000	4,126,185	4,079,066	3,724,231	1,048,108	147,943
Colombia	3,067,568	3,007,935	2,844,251	2,614,092	2,452,635	2,416,432	1,833,606
Trinidad	2,710,515	2,472,943	2,181,676	1,862,796	1,642,446	1,533,122	1,345,532
Argentina	2,651,448	2,432,857	2,330,063	2,202,304	2,036,903	1,997,706	1,950,499
Peru	1,798,557	9,099,885	2,313,691	2,331,454	2,260,903	2,161,990	1,756,867
Bahrein	1,034,982	1,130,734	1,058,557	635,555	173,072	39,008	4,293
Burma	1,052,708	1,039,960	1,083,391	1,047,593	991,456	1,004,951	982,233
Canada	997,391	879,921	378,478	190,495	182,820	178,233	144,686
Brunei	767,700	707,123	576,545	470,991	471,842	386,478	290,808
Great Germany: Old Reich	647,337	552,074	453,451	444,600	427,400	317,500	238,600
Ostmark	109,904	63,468	33,010	7,473	6,616	4,172	860
Slovakia and Moravia	18,103	19,282	18,036	18,665	19,946	25,971	17,776
Poland	522,874	504,678	501,301	510,630	614,760	529,200	550,670
Japan	379,161	356,328	341,040	341,976	326,580	266,520	212,667
British India	306,765	322,125	298,450	273,137	281,072	265,341	224,879
Ecuador	306,824	319,877	306,326	275,293	245,434	231,947	229,578
Saudi Arabia	536,366	66,683	8,070	2,447	Nil	Nil	Nil
Sarawak	171,322	200,126	217,085	221,126	253,799	277,513	315,259
Egypt	648,780	223,058	166,298	177,491	176,436	214,671	232,437
Italian Empire: Albania	208,279	65,313	56,760	32,760	6,152	2,500	1,707
Italy	11,346	13,178	14,000	16,106	15,977	20,180	26,526
France	70,224	72,106	71,008	74,788	74,172	98,025	110,120
Hungary	103,364	42,798	13,910	13	Nil	Nil	Nil
Bolivia	11,904	13,262	15,487	13,197	20,540	19,858	14,085
Other Countries	82,300	34,080	10,000	5,300	4,600	9,100	7,700
WORLD TOTAL	283,786,952	279,111,097	279,482,962	246,449,340	226,610,486	207,971,753	197,034,849

THIS FASCINATING OIL BUSINESS

"This Fascinating Oil Business," by Max W. Ball; 440 pp; published by Bobbs Merril; $2.50

MAX W. BALL has taken on a task that has long needed doing and he has made a good job of it. In "This Fascinating Oil Business" he takes the reader on a tour of the petroleum industry and introduces him to the men who make it go from geologist to service station operator and research expert. In successive chapters he deals with the nature and origin of oil, the theory and practice of geology, leasing, drilling, transportation, refining, marketing and research, while the final section is devoted to a brief review of the world's oil fields and a discussion of the part that oil is likely to play in the European war.

Max Ball

Not the least difficult undertaking in preparing a work such as this is to put into language that is clear and understandable to those whose knowledge of the methods of finding and processing oil is of the sketchiest an explanation of the factors involved and their relation one to another. To discuss anticlines and synclines, closed domes, lenses and stratigraphic traps with a group of geologists is a simple matter compared to the task of making the subject intelligible to an audience to whom the very terms are as so much Greek.

Similarly the drawing of a picture of modern refining processes which will convey a clear impression of the combination or transformation of molecules through the magic of modern chemistry, is something that few men could accomplish with the apparent ease and certain success that attends Mr. Ball's effort. Throughout his book the author carries his story with a deft touch and with occasional humorous asides that make easy and entertaining reading of what might easily have been a drab and tedious narration. Though couched in non-technical terms the book is technically accurate and as the author observes with evident satisfaction in taking leave of the subject it contains not a single table, chart or form from beginning to end.

No doubt the success of Mr. Ball's essay in authorship is due in good part to his own long and varied experience in the oil business. By education and profession a geologist he served for a matter of ten years with the U. S. Geological Survey and later as engineer and law officer of the U. S. Bureau of Mines. For four years he was in charge of exploration work in the Rocky Mountain area for the Shell group. Following that he put in seven years as president of producing and pipelines affiliated with Standard of Indiana. As a consulting engineer and geologist he has had broad contact with conditions in all branches of the industry. His friends in the fraternity will note the commendable restraint which he has exercised in referring only briefly to his recognized hobby, the utilization of the oil sands of Northern Alberta in Canada.

Oil men will enjoy Mr. Ball's book and it will prove invaluable to others who wish to inform themselves regarding the essentials of the petroleum industry. Its title is well chosen for in "This Fascinating Oil Business" Max Ball has produced a really fascinating story.

Producing Well Reported In Turkey

A MESSAGE from Ankara under date of April 29 announced that the first producing well in Turkey had been brought in at Besiri, east of Diyarbakir. Exploratory drilling has been under way at this point for some time under the auspices of the Turkish Petroleum Institute. Details of the discovery well are lacking but it is stated that it indicates the existence of a field of substantial extent.

Calls Oil Control Bill "100 Percent Nazi"

Smoke Screen: By Samuel B. Pettengill: 121 pp; Southern Publishers, Inc., 1940.

FORMER Representative Samuel B. Pettengill has followed his earier books, "Hot Oil" and "Jefferson the Forgotten Man", with a third to which he has given the title "Smoke Screen". The thesis that Mr. Pettengill puts forward in this new volume is that the federal administration is steadily absorbing the rights of the states and of individual citizens and is pushing the country toward national socialism of the Nazi model. His claim is that this is being done not openly but in the guise of "liberal" legislation which ultimately may destroy all liberty.

The book is of interest to members of the oil industry because Mr. Pettengill cites the oil control bill now pending in Congress and the manner in which it has been put forward as an example of the attempt to alter the fundamental structure of American government. He says:

> "This bill, if enacted, will give the Secretary of the Interior not only final absolute power to prescribe all means and methods by which petroleum is produced, e.g., how many wells shall be drilled, how far apart and who shall drill them, but also to determine for what purposes petroleum and all its products may be used. He could prescribe what proportion of the product may be used for gasoline, fuel oil and any other of the hundreds of petroleum derivatives. In granting him this power the bill would relegate to the background the authority of all state governments to deal with the subject matter."

After pointing out that the bill goes further than the Agricultural Adjustment Act or the Wagner Labor Act in placing authority over production within a state under control of Washington bureaucrats, Mr. Pettengill stigmatizes it as "100 percent Nazi" and adds, "It would wipe from the books all state legislation and all regulations of its petroleum conservation agencies which might conflict with any regulation or order issued by the Hon. Harold L. Ickes or any successor as Secretary of the Interior or any agent named and controlled by him." In final warning the author states that if the attempt at federal control over oil is successful other industries will follow the same course until all are engulfed by an all powerful central autocracy.

World's Fair Opens

"New lighting and color scheme will enliven the great, luminous blue, three-sided building both inside and out", said T. H. Taylor, president of the Petroleum Industry Exhibition, referring to the opening of the World's Fair in New York for 1940.

Mr. Taylor continued:

"Inside the great hall softly glowing light from concealed tubes will grow from faint green to golden yellow illuminating a tremendous turquoise blue canopy 80 ft. above. Four giant oil tanks will hold exhibits covering several of the dramatic phases of oil which will be so presented as to contrast sharply the swift, sure comforts of today with the slow uncertainties of the past.

"The giant derrick which proved a landmark in the Fair of 1939, will again be in operation this year. On the floor of the derrick, one of the tallest in the world, oilfield men from the southwest will show how they drill for the magic fluid. With little more than a gesture they send the 15-ton crown block to the top of the 200-ft. derrick or bring it sliding down to stop within a fraction of an inch."

The sculptured map with its moving railroads, miniature derricks, mountains and streams, the miniature refinery and the technicolor animated cartoon movie add to the attractiveness of the petroleum exhibit which opened on May 11.

At the Tulsa Show . . . . .

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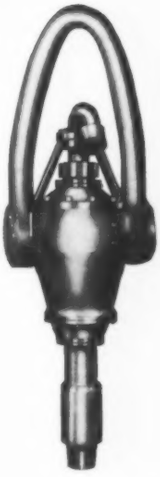

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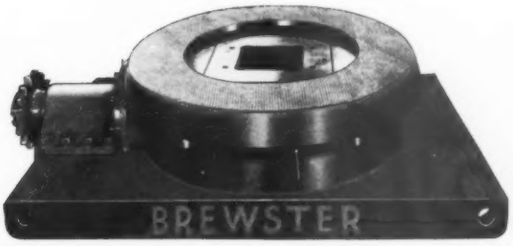

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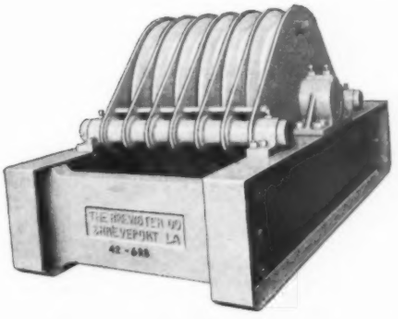

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WORLD PETROLEUM ABSTRACTS

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing With Technical and Economic Aspects of the Petroleum Industry. Edited by Dr. O. W. Willcox

CHEMISTRY

Catalytic Effect of Metals on the Ageing of Lubricating Oils for Diesel Engines—H. L. Matthijsen, in JOURNAL INSTITUTE PETROLEUM, Vol. 26 (1940), No. 196, pp. 72-90.

During examination at regular intervals of the used lubricating oils from the Maybach engines of the triple car-Diesel trains belonging to the Netherlands Railways, the question was raised as to whether the small metal splinters present in the used oil and also the cylinder-wall, the piston-rings, etc., might be able to increase or reduce the content of oxidation- or ageing-products.

The method of study adopted for investigating the matter was to put 100 grams of the oil into a sheet-iron box along with small turnings of the 12 metals considered. Inside the box is a circular saw running at 2,800 r.p.m. to serve as an agitator. The oil is heated at 230° C. and kept at that temperature for 85 minutes, after which any changes in the oils are ascertained by an analysis. The results are stated thus:

All the ferrous metals stimulate ageing more or less.

The non-ferrous metals have no catalytic effect at all, or a negative one.

The minute iron splinters in the used lubricating oil from the Maybach diesel engine, and also the cylinder wall, piston-ring, piston, etc., will therefore alter the content of oxidation products.

From the investigations into the effect of the addition of copper as very fine turnings to a paraffin base oil (A) and to a naphthene base oil (B) during ageing progressively from 100° C. to 230° C. in the oxidation instrument, it is evident that the catalytic effect of copper is very different in the case of the two lubricating oils.

With the paraffin base oil the catalytic effect up to 180° C. is clearly but weakly positive, whereas above 180° C. copper strongly represses the ageing.

There is only a slight catalytic effect over the whole range of temperature with the naphthene base oil.

Partial Oxidation of Petroleum and Natural Gas—W. L. Faith, in REFINER, Vol. 19 (1940), No. 3, pp. 68-72.

As one phase of an effort to build up an auxiliary chemical industry within the petroleum industry, a beginning is being made toward partial (or controlled) oxidation of petroleum and natural gas as a means of obtaining valuable intermediate products. In these processes the only materials needed, besides petroleum and a catalyst, is air; the possible products include nearly the entire range of oxidized hydrocarbons. By varying the time, temperature, pressure, concentration and the catalyst as well as he raw material, the operator can make nearly anything that consists of the three elements carbon, hydrogen and oxygen. Most of the major oil companies have carried on research in this field and a few of them have even developed the processes to the semi-works stage. Although some of these projects have been abandoned as uneconomical at present, others are being continued.

Of the processes being operated commercially few operating details are available. One major oil company is manufacturing carload lots of methanol and formaldehyde by the oxidation of natural gas. Operating conditions probably include pressure in the neighborhood of 250-350 pounds per square inch, elevated temperature, and a low oxygen-hydrocarbon ratio. Several metals and oxides including platinum are known to catalyze this reaction, but it is possible that the chemical nature of the substance is not nearly so important as time of contact.

Another commercial process is the oxidation of ethylene to ethylene oxide. Patent literature indicates that a catalyst consisting primarily of silver is used, that pressures up to 50 atmospheres, and temperatures ranging from 300° to 400° C. are employed.

Just what other partial oxidation processes will be added to these in the next few years cannot be predicted.

Catalytic Dehydrogenation of Representative Hydro-Carbons—Alex G. Oblad, Robert F. Marschner, and Llewelyn Heard, before Petroleum Division, AMERICAN CHEMICAL SOCIETY, Cincinnati Meeting, April, 1940.

Representative hydrocarbons of all classes have been dehydrogenated over chromic oxide catalysts using identical reaction conditions. Cyclohexanes are converted to aromatics and hydrogen for extended periods without extensive formation of gaseous and residual by-products. Paraffins are much less rapidly converted and the activity of the catalysts declines rapidly through deposition of elementary carbon. Olefins are more readily converted than paraffins, but the activity decline and carbon deposition are far more pronounced. Cyclopentanes are slowly dehydrogenated but closely resemble olefins in carbon deposition. Simple methylated aromatic hydrocarbons are unaffected but alkyl aromatics with longer side-chains, such as ethylbenzene, slowly dehydrogenate, giving tar-like by-products which strongly poison the catalysts.

Solubility of Cracked Residues in Some Solvents—J. Voskuil, in JOURNAL INSTITUTE PETROLEUM, Vol. 26 (1940), No. 196, pp. 57-71.

When cracked residue and fuel oil containing this product are diluted with different quantities of a precipitant hydrocarbon, and the percentages of precipitate are plotted against the dilution, "precipitation curves" are obtained. These lines are practically horizontal at high dilutions of aliphatic hydrocarbons and for *cyclo*hexane. When adding large amounts of benzene to a cracked residue not containing sludge, a certain amount of precipitate is also formed. This precipitation curve is also horizontal at high dilutions. In the presence of sludge, small quantities of benzene may peptize part of the sludge, whereas larger quantities may again increase the amount of the precipitate; so a minimum in the curve is formed.

Approaching the matter from a different experimental standpoint, when the insoluble components of a cracked residue are precipitated with pentane, and the precipitate is filtered off and treated with a large quantity of benzene, practically the same amount of insoluble material is found as when treating the original residue with this amount of benzene. This experiment shows that the pentane maltenes show no, or only a very small, peptizing effect in benzene solutions. If, however, the precipitate with pentane is extracted with solvents of increasing aromatic content (gasoline-benzene mixtures), the total amount of substances insoluble in benzene increases, showing that that part of the asphaltenes which is soluble in these mixtures is necessary to peptize part of the material in itself insoluble in benzene; these fractions of the asphaltenes must be regarded as the mantle substances of the cracked nuclei in the solution in benzene.

From the amount of benzene-insoluble substance left after extraction, a mathematical expression is found for the relation between the dilution and the amount of benzene-insoluble material, because all the nuclei and their mantles were precipitated with pentane, and after that the mantles were quantitatively removed. In the dilution experiments, however, these protective bodies remain present, but their influence cannot be expressed in a simple mathematical expression.

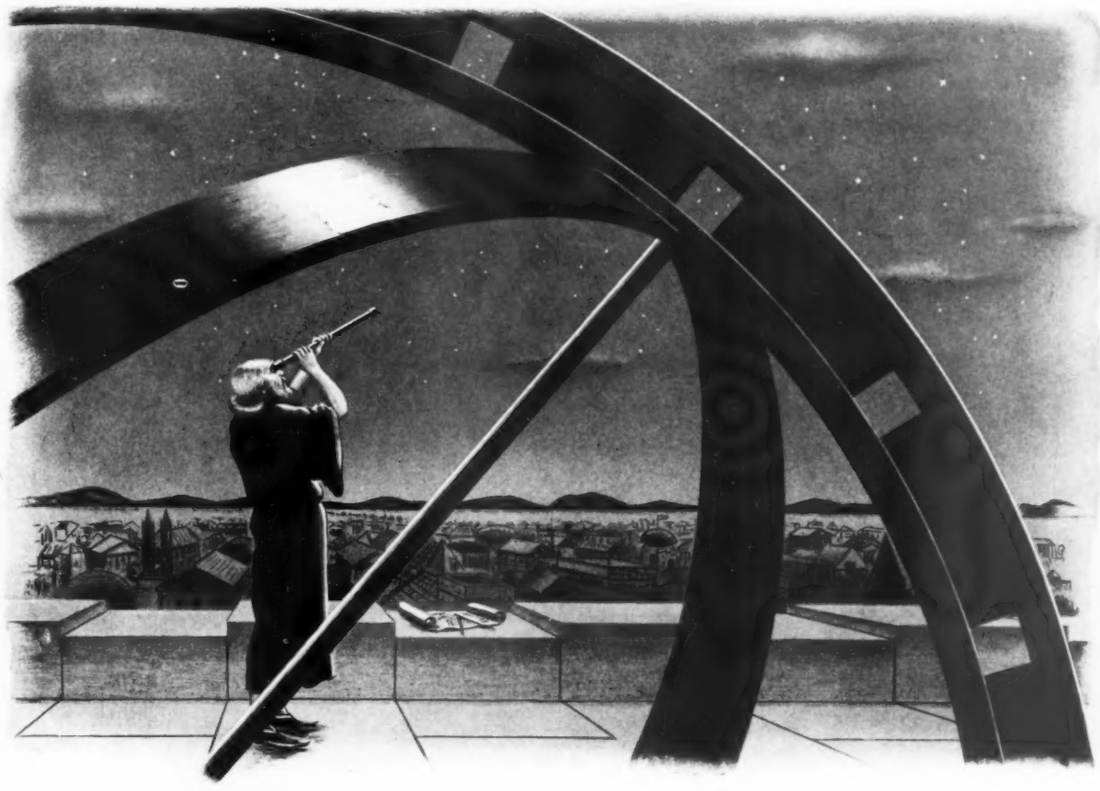
USE

Polybutenes, Their Properties and Uses in Petroleum Products—R. M. Thomas, J. C. Zimmer, L. B. Turner, R. Rosen and P. K. Frohlich in INDUSTRIAL ENGINEERING CHEMISTRY, Vol. 32 (1940), No. 3, pp. 299-394.

Polybutenes of high molecular weight (such as the commercial products knows as Vistanex Polybutene LM, MM and HM and Exanol) may be obtained by the polymerization of iso-butene. These products have many uses in diversified fields; their chief interest to the petroleum industry lies in their solubility in liquid hydrocarbons and their valuable property of greatly improving the viscosity index of petroleum oils. This use of the polybutenes is now established on a commercial basis, and manufacturers of lubricating oils can obtain concentrates for blending purposes.

The solutions of the higher polymers are of particular value as additives to greases and special lubricants. For a long time rubber, dissolved in mineral oils or more lately in the form of latex, has been added to greases to impart "string" and adhesiveness; but since rubber is subject to oxidation the rubber-compounded greases soon lose their stringiness. Because of their marked chemical stability the polybutenes are superior to rubber in this respect.

In addition to its use in greases the application of stringiness additive to lubricating oils for sleeve or other open-type bearings has been found



AN UPHEAVAL not foretold . . . .

The astrologers searched the stars . . . foretelling the future in the light of their then present knowledge.

They predicted wars and revolutions . . . sometimes with uncanny accuracy . . . but one bloodless upheaval they could not foresee was the "industrial revolution." Nor could they guess the great part Centrifugal Force would play in the chemical and industrial developments thus initiated.

These astrologers did not even suspect the extent of the dependence of our present day civilization upon Petroleum . . . they knew nothing of "Motor Fuel"—"Aviation Lube"—"Medicinal White Oil" . . . products made commercially possible through the use of Centrifugal Force.

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advantageous since the string imparted by this means often reduces oil leakage and consumption in the bearing without increasing power consumption or frictional drag. Applications of this type include textile lubricants, mine car lubricants, castor machine oils, and special lubricating oils for the food industry where drippage and excessive oil consumption must be avoided. Also the polybutenes of medium or higher molecular weight range are finding an outlet in oils used in making paper-impregnated insulation for electric cables. The main advantage is a reduction in the migration of the oil which is brought about by the large increase in viscosity.

Another use of polybutenes is in compounding with asphalts, to which they impart higher values for softening point, accompanied by an increase in penetration, thus improving the softening point-penetration relation; the ductility is somewhat lowered. The effect of polybutenes upon the aging characters of asphalts is also of considerable interest; they tend to reduce the liability of cracking. This seems to point to the possible use of such blends in coating pipe lines.

Blending polybutenes with paraffin wax increases the viscosity of the wax and lessens the tendency to "strike through" surfaces to which it is applied. Brittleness, chipping and tendency to crack are minimized even at very low temperatures. The bonding strength of the wax is enlarged.

Lubricating Oils with Additions—Michel Roegiers, in REVUE PETROLIFERE, 1940, No. 880, pp. 191-192.

It seems to be the opinion of a number of specialists in the field of lubricating oils that oil improvers ("dopes" added to lubricating oils) have the function of inhibiting or retarding the oxidation of the oils to which they have been added.

The author, who has been associated with Belgian manufacturers in the preparation of lubricating oil improvers by an electrical process, takes issue with this view. The prototype of these electrochemically produced substances is Elektrion R. which is a viscous "concentrate" of molecules from oils that have been electrically treated. When added to ordinary lubricating oils they increase the viscosity, improve the viscosity index, lower the cold point and in general confer a greater "oiliness".

But numerous tests show that these additions do not affect the oxidizability of the lubricating oil one way or another. The role which they fill amounts to that of a "third solvent", which keeps the products of oxidation, that otherwise would separate out in the form of gum, in solution. This solvent effect is shown by the following experiment: An ordinary lubricating oil having a viscosity of 200 in. Saybolt at 100° F., when heated in an oven to 150° C., began to form a precipitate after 10 hours, which increased as the heating was prolonged. The same oil, after receiving additions of 5, 10 and 15 percent of Elektrion R and being heated in like manner required periods of 150, 200 and 250 hours before the appearance of a precipitate. So long as the point of saturation with products of oxidation was not reached, the oil remained limpid even in thin layers.

That the phenomenon involved is a true solution of the products of oxidation was confirmed by precipitating these products by sufficiently diluting the oil with a light distillate. It seems that this solvent action applies to all kinds of oil.

Aside from this solvent action the electrochemically treated addition products are credited with a peptizing action on particles of carbon which are formed during operation of the engine. When in that condition the carbon particles are not deposited on the metal parts of the engine, and they are not agglomerated when the oil-carbon emulsion accidentally comes into contact with water.

Relation Between the German Ordnance Test Engine and the Starting Value of Diesel Fuels—Paul Weber, in OEL UND KOHLE, Vol. 36 (1940), No. 9, pp. 78-89.

For military purposes the readiness of a Diesel oil to "start" or ignite, is a property of outstanding importance when prompt action is demanded.

Hence in acceptance tests for fuel for tanks and other military machines great stress is laid by the ordnance department on ignition quality.

Of a Diesel fuel it is required, first, that at a certain minimum temperature it will flow to the injection pump without clogging the fuel pipe and the oil filter. Hence cold point and filtrability are carefully investigated. After the fuel has reached the injection pump it must show a certain promptness in igniting in order that the engine may make a quick start.

For testing ignition quality the German Ordnance Department has developed its own test engine and testing method. The actual test may be carried out by either one of two methods. The time between injection of the oil and the moment it catches fire is the "ignition delay". In practice, it is preferred to obtain an indirect measure of the ignition quality. The engine may be cooled progressively to a point where the fuel just fails to be ignited, and this critical temperature is recorded. In this form the amount of air injected with the oil is kept constant. In another form of test the temperature of the engine is kept constant, and the amount of air injected is progressively reduced so long as ignition still occurs.

This is referred to as the "throttling method", and is preferred on account of its practical convenience. The amount of air that is just sufficient for ignition is recorded as representing the ignition quality of the fuel. As a reference fuel, use is made of a mixture of cetane and alpha-methylnaphthalin and the results are expressed as cetane numbers.

The problem to be solved in this research was the relation between cetane number and "cold start". The end conclusion is that there is a direct relation, which graphically is represented by a hyperbola and a mathematical expression.

It was also found that ignition accelerators, such as amyl nitrate, while having a rather large influence on the cetane number, contribute very little to ignition quality in the cold.

Diesel Fuels, Diesel Test Fuels, Rate of Change, Self-Ignition and Cetene Number. O. Herstad, in OEL UND KOHLE, Vol. 15 (1939), No. 32, pp. 629-631.

From a series of tests on Diesel fuels available in Norway it is ascertained that the spontaneous ignition temperatures of these fuels range from 600 deg. to 560 deg. C., while corresponding cetene numbers range from 43 to 71. That is, the cetene number and the ignition temperature are inversely related, as will appear from the accompanying figures:

Ignition Temperature	Cetene Number
600 deg. C.	43
590	51
580	58
570	64
560	71

This relation points to the possible use of ignition temperature as a measure of cetene number. However, the methods of determining the temperature of spontaneous ignition needs further refinement if it is to become of general utility, but here is a direction which may well be followed out.

SUBSTITUTES

Substitute Motor Fuels in Britain—Oscar Tokayer, in PETROLEUM PRESS SERVICE, Vol. 7 (1940), No. 6, pp. 64-66.

With Great Britain at war, increasing attention is being paid to the possibility of utilizing the country's abundant coal supplies to take the place of imported liquid fuels. The situation in this regard at the end of 1938 (later figures will probably not be available until after the war) was as follows:

British Output of Refined Motor Spirit (Million Gallons)

	1938	1937
A. From coal, coal-tar and coal-tar oils a) H. T. Carbonisation:		
At coke ovens	31.6	34.5
At gas works	10.5	10.0
Tar Distilleries, etc. b)	12.6	11.8
L. T. Carbonisation	1.3	1.0
Hydrogenation	42.3	35.0
B. From shale	6.8	7.7
Total	105.1	100.0

a) Practically the whole of the output at coke-ovens, gas works, tar distilleries and tar oil refineries was motor benzole.
d) Including refined spirit obtained from crude benzole produced at coke ovens and gas works.

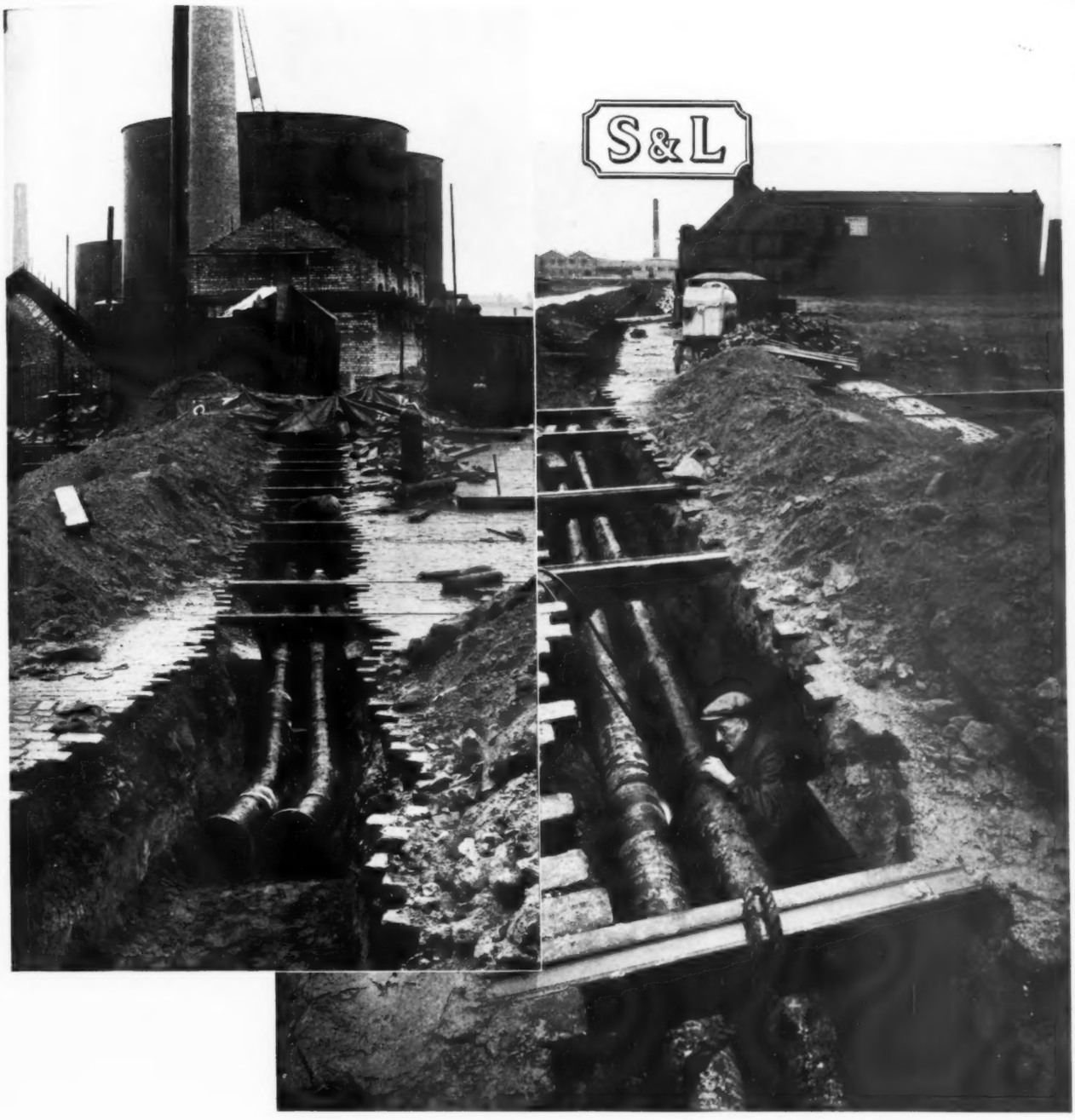
The producer-gas vehicle offers another means of using coal for automotive purposes. A new type of 6-ton truck has been designed and about 25 firms are engaged in its manufacture; these trucks will operate on low volatile anthracite and low temperature coke.

Although figures are lacking for 1939 it is very probable that the amount of motor fuel obtained from coal has increased. The Billingham hydrogenation plant is undoubtedly working close to its maximum capacity—45 million gallons a year. Coke suitable for producer-gas vehicles is being produced at an increased rate but it is unlikely that even 10,000 such vehicles will appear on the roads for a long while to come. The conclusion is that Britain's motor fuel requirements will have to remain based on petroleum to the extent of perhaps 98 percent.

Mineral Oil-Vegetable Oil Blends for Lubricating Internal Combustion Motors—M. Freund and St. Thamm, in OEL UND KOHLE, Vol. 36 (1940), No. 1, pp. 18-26; No. 5, pp. 55-57.

In countries that do not have sufficient native petroleum resources it has long been customary to use vegetable oils for lubrication purposes, either alone or mixed with a larger or smaller proportion of mineral lubricating oil. Castor oil, rape oil and olive oil are the ones chiefly used in this connection. For machinery lubrication these mixtures are more or less satisfactory. However, the use of such lubricants in automotive engines is more objectionable, due to the gumming and corrosion resulting from oxidation at high temperature.

The authors had the idea that if the mineral oil-vegetable oil blend were mixed with an oxidation inhibitor, such as is used in the rubber industry and for stabilizing cracked gasoline, it might be possible to use them in automotive engines with more success. By a series of laboratory experiments they found that various organic inhibitors, including pyrogallol, dioxynaphthalin, various phenols and some others, would retard oxidation under these conditions, whereupon they proceeded to make engine tests;



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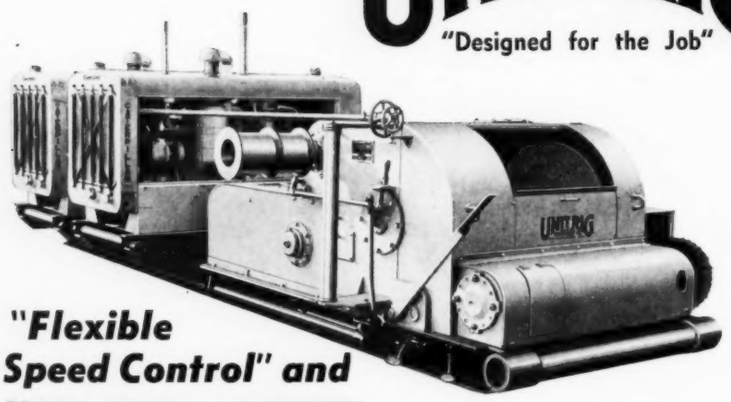

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the data of these tests show notable improvement in the behavior of the mixed blends as regards increase of acid number and viscosity change; ring sticking occurred only after a greatly prolonged use.

Ketones as High-Octane Motor Fuels—Ch. Berthelot in MONITEUR PETROLE ROUMAIN, Vol. 41 (1940), No. 4, pp. 205-210.

The demand for aviation fuel of higher and higher octane number is becoming more insistent. The difference in power delivery by gasolines of 90 and 100 octane number is 30 percent, hence the demand for 100 octane fuel for military requirements. The principal sources of 100 octane fuel are iso-octane and iso-propyl ether, both of which are being produced on a large scale in the United States. By treating these fuels with sufficient tetraethyl lead the octane number may be raised to 120, whereby the power delivery may be increased 50 percent.

This is all to the good for nations that have within their borders the raw materials needed for the preparation of these superfuels. In the United States, for instance, immense quantities of olefins are available in refinery gases; these furnish the basis for the preparation of immense quantities of aviation fuel. The case is different with countries that have insufficient petroleum resources or none at all.

It is pointed out that blending agents fully equal to iso-octane and iso-propyl ether can be prepared in many oil-poor countries from materials that are available in very large quantities. These substances are the ketones, which can be produced in two general ways. One is by acid fermentation of sugar obtained from plants rich in carbohydrates, or by the hydrolysis of waste vegetable matter. The organic acids obtained by fermentation are easily converted into ketones which have octane numbers up to 120 and other desirable properties. The other way is to build them up by synthesis from acetylene and water.

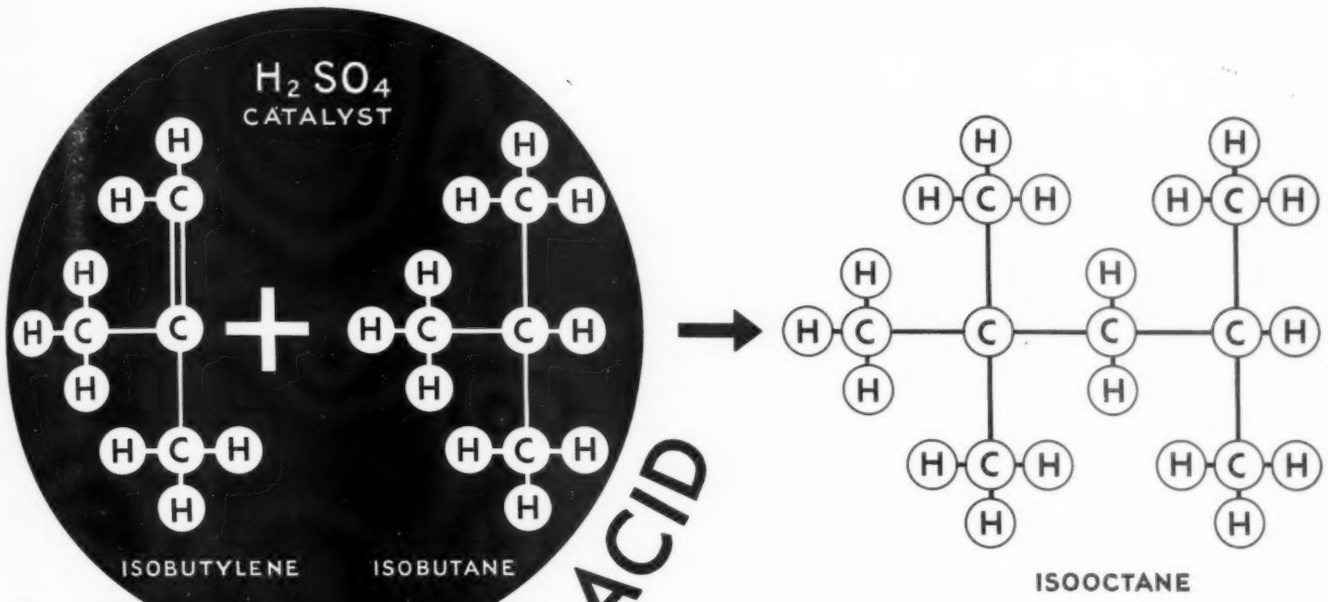
It is admitted that either process is expensive.

British Coal Oil Production—B. Orchard Lisle, in REFINER, Vol. 19 (1940), No. 3, pp. 63-67.

There are 13 low-temperature coal carbonization plants and one plant that hydrogenates coal by the Bergius process in Britain. The total production of coal oil by all plants, including high-temperature gas works, coke ovens and tar distilleries in 1938 was 2,808,800 bbl. of which 1,208,600 bbl. was produced by the Billingham hydrogenation plant and 37,200 bbl. by low-temperature carbonization.

Production of petroleum substitutes by low-temperature carbonization appears to have a better outlook at present than by hydrogenation on account of the smaller overhead, provided that the new methods of disposing of the by-product coke can be generalized. In the newer forms of the carbonization process the coke is obtained as an excellent smokeless fuel which should go far to abate the well known smoke nuisance that plagues British cities. If this superior coke finds the market which it seems to deserve, the production of gasoline and oils convertible to gasoline could be raised to about 30,000,000 bbl. as a limit, which is much more than the present British gasoline consumption. However, it remains to be seen whether coke consumption can be expanded to the limit that would make production of this amount of gasoline a possibility. Britain would not thereby escape the importation of some petroleum, as the products from coal do not furnish high class lubricating oils.

The liquid obtained by low-temperature car-



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bonization of coal is now worked up in a continuous distillation process similar to that employed in petroleum refining. The distillation products include 10 percent gasoline, 15 percent Diesel oil, 16 to 18 percent cresol, 59 to 61 percent creosote and fuel oil and the remaining 20 percent is pitch.

ECONOMICS

Ecomomic Dynamics of the Domestic Demand for Motor Fuel—Norman D. FitzGerald, in PETROLEUM TECHNOLOGY, Vol. 3 (1940) No. 1, Technical Publication No. 1174; 7 pages.

Multitudes of influences are at work determining the expansion and fluctuation of demand for motor fuel. The primary components are the number of motor vehicles registered, price of motor fuel to the consumer, miles of hard-surfaced highways and national income. These factors influence one another but are largely determined by a group of secondary constituents.

The net resultant of these and many other influences bearing on motor-fuel demand appears to be adequately expressed by factors in the following series.

D = annual domestic demand for motor fuel, millions of barrels.

R = millions of registered motor vehicles.

P = average price of motor fuel to consumers in 50 cities, cents per gallon tax included.

HT = thousands of miles of hard-surfaced highways, partly estimated, represented by H. The number of years from 1924, represented by T as a multiplier.

N = national income, billions of dollars.

After the computation of coefficients by the methods of multiple correlation, the equation derived for relating the domestic demand for motor fuel to the several elements is as follows:

$$D = 17.965R - 7.199P + 0.023HT + 0.409N$$

As might be expected, the number of registered cars is the prime factor behind the demand for motor fuel as shown by the relatively large coefficient for R(17.865). But price is also important, because its coefficient is also considerable (—7.199). The negative sign before P indicates that the demand falls as the price rises.

World Trade in Lubricating Oils—Oscar Tokayer, in PETROLEUM PRESS SERVICE, Vol. 7 (1940), No. 6, pp. 61-64.

From available statistics for the period 1936-38 (figures for 1939 are not yet accessible) the relative importance of different countries as producers of lubricating oils are given as follows:

Lubricating Oil Production (Thousand long tons)

I. Based on domestic materials	Production 1938	1937	1936
United States	4,315.7	5,944.9	4,329.8
Russia	—a)	—a)	—a)
Venezuela/D. W. Indies	333.8b)	324.9b)	184.2b)
Burma	66.6	62.4	59.3
Roumania	64.4	48.1	61.8
Argentina	55.0	50.3	44.0
Mexico	51.5	72.9	80.3
Poland	46.8	44.9	61.2
Dutch East Indies	24.7	31.8	22.9
II. Based mainly on imported materials			
Germany	400.0d)	336.3	265.9
France	194.1	171.4	168.2
United Kingdom	145.0	132.4	106.5
Italy	85.4	70.3	27.2
Canada	86.5	91.8	78.9
Belgium	.....	.....	.....
Others	49.9	47.1	41.7
Total	5,919.4	6,429.5	5,531.9

The great preponderance of the United States in this trade, followed at a long distance by the group Venezuela-Dutch West Indies, is notable.

Imports of finished lubricants are still of importance even for consuming countries that have refining plants of their own. The relative importance of the importing countries are given as follows:

World Imports of Lubricating Oil x) (Thousand Long Tons)

	1938	1937	1936
United Kingdom	415.4	451.5	445.3
Germany a) b)	390.0	415.7	386.2
Belgium a)	174.9	180.6	157.1
British India c)	144.3	134.5	77.7
France	68.7	85.0	96.9
Canada	64.7	61.3	57.2
Australia	61.9	69.7	61.5
Sweden	61.4	56.2	46.7
Holland	52.9	49.2	46.2
Italy	43.3	69.9	54.2
Union of S. Africa	37.6	41.4	32.4
Brazil	37.4	38.1	30.9
Denmark	30.7	25.0	30.5
China	23.1	41.7	43.6
Philippines	20.6	12.0	10.1
Czecho-Slovakia	19.5	23.2	19.0
Switzerland	19.0	20.1	16.8
Finland	13.9	13.4	11.6
British Malaya	13.9	19.2	12.5
New Zealand	12.8	16.6	11.6
Norway	12.2	13.4	12.4
Algeria	12.1	12.2	10.3
Chile	11.8	11.5	9.2
Eire	10.4	10.6	10.3
Portugal	10.4	11.4	8.8
Other countries	217.1	237.1	178.3
Total	1,980.0	2,120.5	1,877.3

a) Including quantities for re-export.
b) Including Austria.
c) Without Burma since April 1937.
x) Excluding Japan and possessions.

Aside from the United States, the four largest consumers are the United Kingdom, Germany, Belgium and British India. In 1938 these four countries consumed more lubricating oil than all the others (in the above table) put together.

BOOKS

Survey of American Listed Corporations. Issued 1940 by PUBLICATIONS UNIT SECURITIES AND EXCHANGE COMMISSION, Washington, Paper, 375 pages.

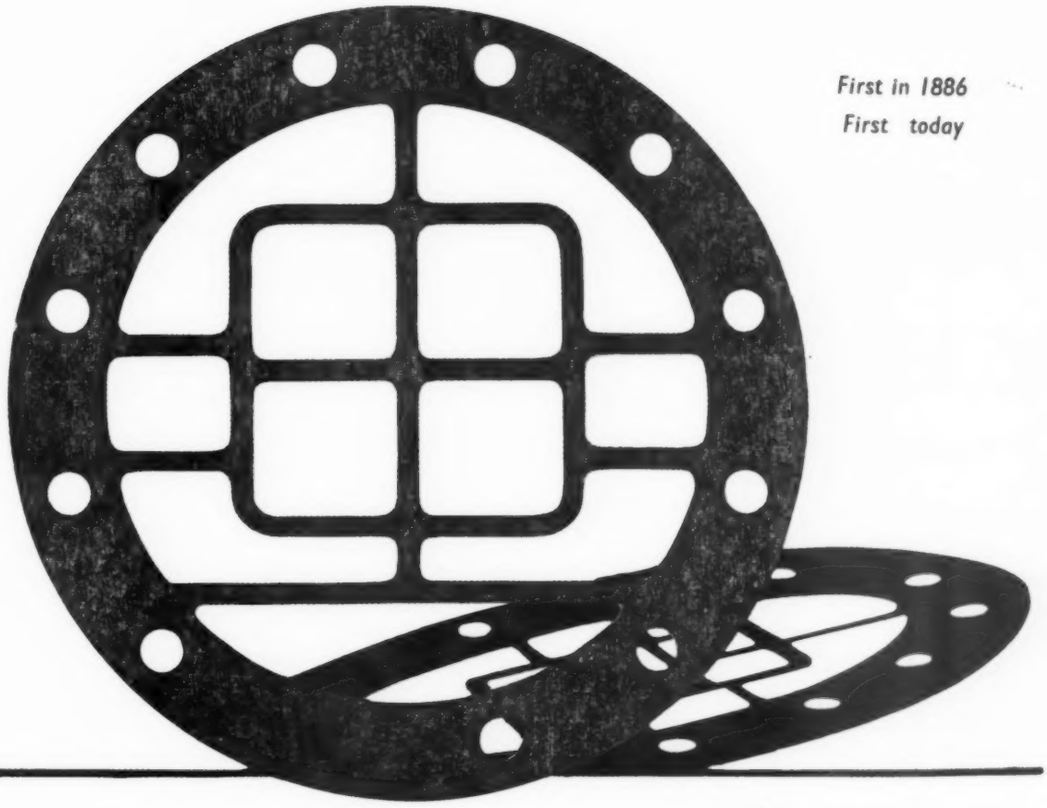
This is volume 2 in a series issued by SEC in fulfillment of the policy of furnishing reliable information concerning corporations that have been listed under the Securities Exchange Act. The information here supplied is intended especially for the investing public.

The present volume includes the information supplied under the law to the Securities Exchange Commission by nineteen oil refining and distributing companies having producing facilities and assets of more than $50,000,000 each (the so-called "majors"). The data given by these companies is very voluminous, and no doubt reflects the position of these concerns up to the date of the report. The following passages appear in the summary:

The combined volume of business for all nineteen enterprises amounted to 4,035 millions for the fiscal year ended on or about December 31, 1938, compared with 4,391 millions for 1937.

The combined operating profit of 332 millions or 8.2 percent of sales was reported by all nineteen enterprises for the fiscal year ended on or about December 31, 1938, compared with an operating profit of 620 millions or 14.1 per cent of sales for 1937. These results were after combined charges for depreciation, depletion, etc., of 439 millions or 10.9 percent of sales for the year ended on or about December 31, 1938 and 430 millions or 9.8 percent of sales for 1937. All nineteen enterprises reported operating profits for both 1938 and 1937.

A combined profit after all charges (including non-operating gains and losses, prior claims, interest, and income taxes) of approximately 272 millions or 6.7 percent of sales was reported by these nineteen enterprises for the fiscal year ended on or about December 31, 1938, compared



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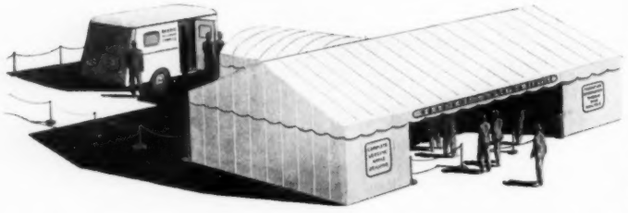

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with 523 millions or 11.9 percent of sales for the previous year. All nineteen enterprises reported net profits after all charges for both 1938 and 1937. Dividends paid by all nineteen enterprises during the fiscal year ended on or about December 31, 1938 totaled 190 millions, of which 13 millions were current cash dividends on preferred stock, 166 millions cash dividends on common stock, and 11 millions stock dividends on common stock. In the fiscal year ended on or about December 31, 1937, dividends paid out totaled 273 millions, of which 10 millions were current cash dividends on preferred stock, 2 millions stock dividends on preferred stock, 255 millions cash dividends on common stock, and 6 millions stock dividends on common stock.

The combined total for all surplus accounts for these nineteen enterprises increased 246 millions in the fiscal year ended on or about December 31, 1937, and in the next year 41 millions to 2,079 millions on or about December 31, 1938. Excluded from these increases are the amounts reported for the interim period of December 1937 by Empire Gas and Fuel Company which, if included, would reduce the aggregate increase by 61 million.

The combined balance sheet assets for all nineteen enterprises totaled 7,595 millions on or about December 31, 1938 compared with 7,586 millions in 1937.

GENERAL

Cooperative Motor Gasoline Survey, Summer of 1939. E. C. Lane in BUREAU OF MINES REPORT OF INVESTIGATIONS 3492, February, 1940; 30 pages.

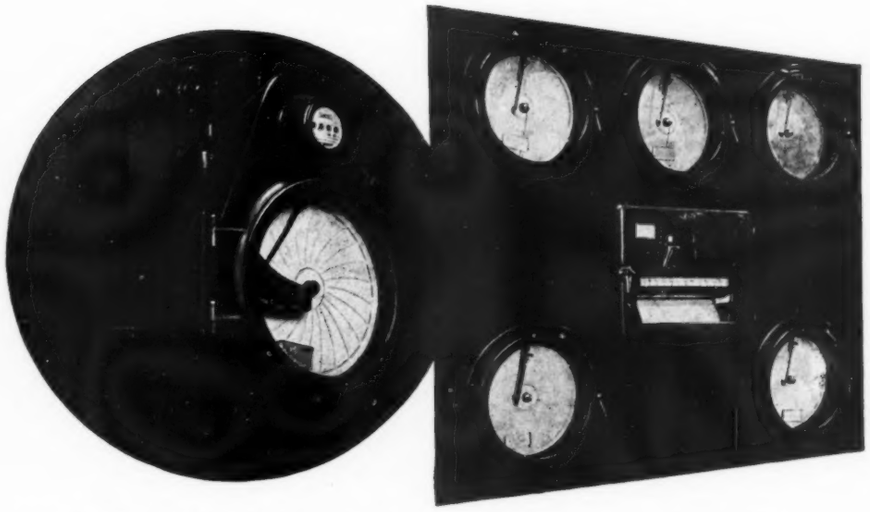
This is the eighth in a series of reports on properties of commercial motor fuels, made in accordance with a cooperative agreement between the Cooperative Fuel Research (C. F. R.) Committee and the Bureau of Mines. The present report, covering 1,679 samples, represents the products of 118 companies plus those from the Pacific Coast.

The three groups of data on samples of regular, premium, and third-grade gasolines are averaged separately. The number of samples and brands representing each grade are as follows: Regular price, 869 samples, 76 brands; premium price, 452 samples, 45 brands; third-grade, 358 samples, 82 brands.

Out of the 1679 samples, only a third-grade gasoline collected in the Pittsburgh area, was reported as giving a positive copper-strip corrosion test.

A comparison of data for the summers of 1939 and 1938, respectively, for the three grades of gasoline, shows that the spread of 90 percent of the regular-price grade is both higher and wider by approximately one octane number for the summer of 1939 than for the summer of 1938. The spread of 90 percent of the premium-price grade is virtually unchanged from the summer of 1938, but for the third-grade gasolines this summer the spread of 90 percent is 3.5 octane numbers higher and 4.5 higher than for last summer.

The ranges of vapor pressures, in which 90 percent of the samples of regular-price, premium-price, and third-grade gasolines are included, are essentially unchanged as to level and spread for this summer as against the corresponding samples during the summer of 1938. The ranges of temperatures in the distillation for regular and premium-price grades of gasoline are essentially unchanged although slightly lower than for the summer of 1938. The middle range of temperatures



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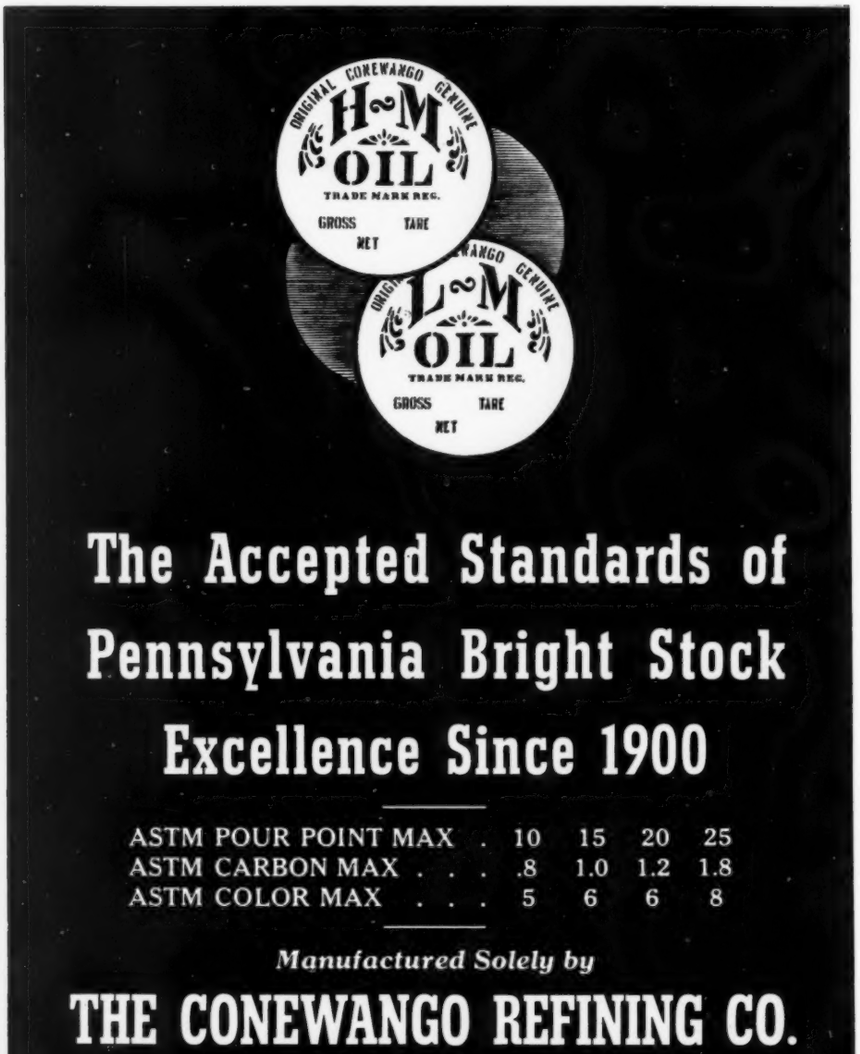

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in the distillation for the third-grade gasoline is appreciably lower than for the summer of 1938.

Some Factors Affecting Tank Steamer Transportation. V. R. Garfias and J. W. Ristori before AMERICAN INSTITUTE MINING ENGINEERS, New York meeting, February, 1940.

For calculating cost and a comparison of the availability by tank steamers of the various exporting to the importing centers (and notwithstanding the fact that outside of American waters and certain restricted routes it is much cheaper to operate a foreign than an American tanker) the authors take as a type in this study a tank steamer of American registry of 10,000 D. W. T. and a capacity of 100,000 bbl. which operates under the following conditions.

Speed, knots per hour	12.
Number of crew	42.
Days in port, per trip	6
Cost of tanker per D. W. T.	$ 150.00
Interest on investment, per cent	6
Insurance rate, per cent	5.5
Maintenance, per day	$ 100.00
Stores, wages, provisions, overhead, per day	$ 260.00
Fuel at 90c per barrel, per day, Gulfports	$ 165.00
Port charges per trip	$1.500.00

From the above and other data and tables the approximate cost per barrel of transportation can readily be calculated. Exclusive of canal tolls, it is found that the rates for a 20 day round trip will be 25c. per barrel, and 37c., 49c. and 61c. per barrel for round trips of 30, 40 and 50 days respectively.

As the cost of marine transportation varies directly with the distance between terminal harbors it follows that the use of canals that shorten such distance is economical whenever the tolls represent a saving over the added cost of the longer route that eliminates the use of the canal. Canal tolls are found to average, in U. S. cents per round-trip per bbl. of crude oil: Suez 13¼, Kiel 1, and Panama 10.

At the beginning of 1939 the world's tanker fleets of all countries of all carrying capacities numbered 1,781 bottoms.

Plastics and Resins from Hydrocarbons—Per K. Frolich, in INDUSTRIAL ENGINEERING CHEMISTRY, Vol. 32 (1940), No. 3, pp. 293-294.

The annual non-coal tar resin production of plastics in the United States is now more than twenty million pounds. This is a large and expanding industry which is of direct interest to petroleum producers as an outlet for both their primary and secondary products.

Following is a list of products falling under this general classification which are either now being manufactured wholly or in part from petroleum products, or for which the petroleum industry would be able to supply raw materials.

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2. Cracking-coil tar resins by condensation of highly condensed petroleum hydrocarbons, such as those which are present in the tar bottoms from the cracking operation, with formaldehyde or ethylene chloride.

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4. Polystyrene by polymerization of styrene, which may be produced from ethylbenzene made by alkylation of benzene with ethylene.

5. Polybutene by polymerization of unsaturated gaseous hydrocarbons to give substantially linear polymers ranging in consistency from that of a viscous oil to rubbery materials with molecular weights as high as 300,000.

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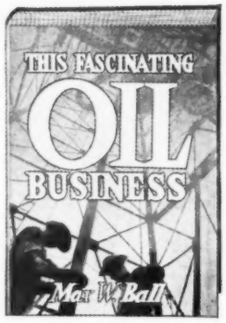

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10. Vinyl resins by polymerization of vinyl chloride and vinyl acetate derived from acetylene or ethylene.

11. Phenol-formaldehyde resins by condensation of formaldehyde with phenols.

12. Alkyd resins by reaction of dibasic acids with polyhydric alcohols—e. g., ethylene glycol and diethylene glycol from ethylene, and glycerol which may be prepared from propylene.

13. Ethylcellulose by reaction of cellulose with ethyl chloride or diethyl sulfate produced from ethylene.

14. Cellulose acetate by reaction of cellulose with acetic anhydride, which may be derived from ketene obtained by thermal decomposition of acetone produced by dehydrogenation of isopropyl alcohol.

15. Acrylate and methacrylate resins derived in various ways from olefinic compounds.

Survey of the Crude Oils of the Producing Fields of Arkansas—O. C. Blade and George C. Branner, in U. S. BUREAU OF MINES REPORT OF INVESTIGATIONS NO. 3486, January, 1940.

This report discusses 25 oilfields in Arkansas and the characteristics of samples of crude oil obtained from 45 wells. Much statistical and historical information about these fields is given.

Probably the most predominant characteristic of the Arkansas crude oils as shown by the analysis in this report is their high content of sulfur. Thus, of the 45 samples analyzed 35 have a sulfur content of 0.7 percent or more, and the average for all is 1.51 percent. The greater amount of sulfur in the heavier samples is not due entirely to deficiency of lighter material.

A study of several physical and chemical properties indicates that to a large degree they change as the sulfur content changes.

The oil samples are classified in four groups with sulfur contents increasing from 0.47 up to 2.25 percent. As the sulfur content becomes larger, the A. P. I. gravity comes down, carbon residue goes up, and the percentages of gasoline and naphtha decrease.

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Gray Clay Treating Units will produce low gum content gasoline without loss of octane number. They will last throughout the life of the cracking unit. Often, when new cracking units have replaced old ones, the Gray Process has again been chosen to treat the gasoline.

In these days, the refiner striving for low cost production, will do well to consider the Gray Process. Moderate installation costs, negligible operating labor expense, low cost of adsorbent, minimum maintenance, are all definite economic advantages.

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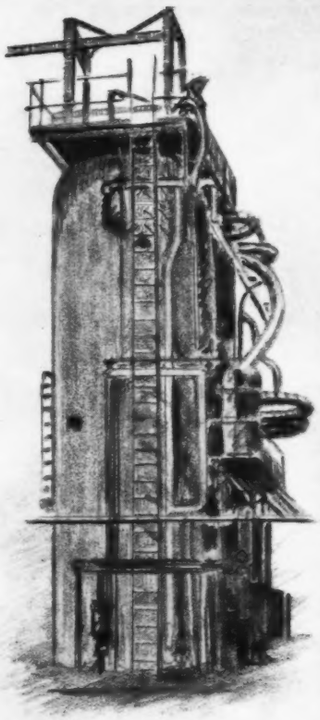

OVER 7 MILLION BARRELS

In 1926 a certain refiner installed a small Gray Clay Treating Unit. To date this unit has produced 7,655,000 barrels of low gum content gasoline.

GRAY CLAY TREATING